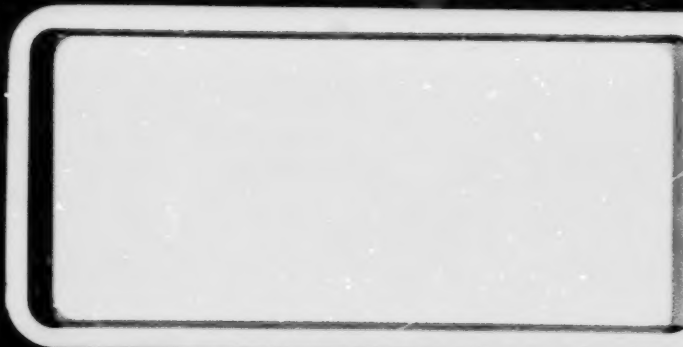


Final report

OWMC
Ontario
Waste Management
Corporation

A provincial crown corporation.



DILLON

SITE SELECTION PROCESS
PHASE 3B:
SELECTION OF CANDIDATE SITES

**Facilities Characteristics
and Technical Buffer Zones**

9494-25
DECEMBER 1984

DILLON

Consulting Engineers & Planners

OUR FILE: F9494-25
YOUR FILE:

13 December 1984

Ontario Waste Management Corporation
2 Bloor Street West
11th Floor
Toronto, Ontario
M4W 3E2

Attn: Mr. R. V. Griffiths, P. Eng.

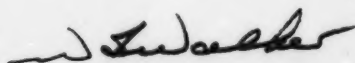
Dear Sirs:

We hereby submit the report entitled "Facility Characteristics and Technical Buffer Zones". The information contained in this report has been developed for OWMC under M. M. Dillon Contracts 9340-01 and 9494-25. Contract 9340-01 covered engineering assistance to the Site Selection Process. Contract 9494-25 covered the preparation of this report.

We believe that this report covers all items discussed during the review period.

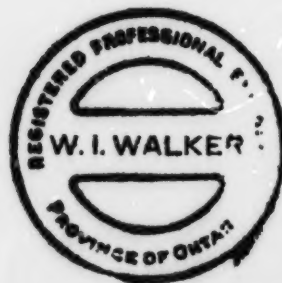
Yours truly,

M. M. DILLON LIMITED



WIW:cmf

W. I. Walker, P. Eng.
Senior Environmental Engineer



ONTARIO WASTE MANAGEMENT CORPORATION
DRAFT REPORT
FACILITIES CHARACTERISTICS AND TECHNICAL BUFFER ZONES

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EXECUTIVE SUMMARY

PURPOSE OF THE REPORT

The purpose of this report is to describe the steps used to establish the following criteria for use in the site selection process.

- Preliminary plant layout and land area required for the operations area.
- Technical buffer zone size required to minimize impacts on the community.
- Overall site size including the technical buffer zone and the area required for the landfill.
- Limits of the study areas in which the effects of normal operations on the community and the environment would be assessed.

In addition, the report provides a review of land use compatibility in Ontario. This is intended to place the sizes of the technical buffer zone and the study areas in the proper perspective.

SCOPE AND METHOD

GENERAL APPROACH

The development of the information covered in this report was carried out in the period June 1983 to January 1984. The work falls into three relatively well defined stages as follows:

- Development of an integrated series of unit processes for waste treatment and a plant layout corresponding to these processes.
- Sizing of the technical buffer zone.
- Development of overall site area requirements.

Development of plant layout

The processing scheme and preliminary plant layout were based on the waste inventory data issued by OWMC in the Spring of 1983. Standard methods of physical/chemical treatment were used to develop conceptual organic and inorganic process trains for the physical/chemical treatment plant. Preliminary equipment sizing was used to establish a layout for the plant.

The layout for the physical/chemical treatment plant was combined with estimated sizes for the incinerator and the solidification plant. In the latter case, size requirements were based on other plant designs developed for a facility located in the United States.

The basic plant sizes were then combined with the required ancillary features such as storage areas, unloading areas, office buildings, maintenance facilities and laboratory facilities to establish the overall plant layout and area requirements.

Development of technical buffer zones

A survey of existing Ministry of the Environment (MOE) approved separation distances for various industries showed that there was little consistency in the approved distances between the various types of plants reported. Additionally, there was no specific instance which covers waste treatment plants of this type. It was, therefore, decided to base the calculations for the technical buffer zone on a "worst case" scenario which would result from an accidental contaminant release from the plant.

The OWMC waste slate was again used to determine what potentially hazardous chemicals might be present. Potential accident situations were postulated and emission rates calculated for each case. Air dispersion calculations were then carried out using the methodology specified in Ontario Regulation 308, a regulation under the Environmental Protection Act (1971).

The technical buffer zones for the physical/chemical treatment plant and the incinerator were specified as the greatest distance required to meet the emission levels specified in Ontario Regulation 308. Separate buffer zones were calculated for both the incinerator and the physical/chemical treatment plant. Analysis of the solidification plant design and operations showed that there would be no emissions which would be of concern under Ontario Regulation 308.

Development of site sizes

The OWMC waste inventory data were used to develop a conceptual material balance for the proposed facility. This material balance was used to develop the quantities of treated solidified waste which would be landfilled. These quantities were used to establish the landfill areas required for various solidification processes, for various landfill types and for various waste input rates.

The waste input rate was fixed at 300 000 tonnes/year. A range of solidification agent additive ratios was examined and 1.0:1 was selected as appropriate for landfill area requirement determinations.

At all stages, calculations were carried out for both total and partial solidification options.

The landfill areas developed at this time were compared to the area required for the processing facilities and their technical buffer zone with the larger of the two being selected as the required area.

Development of study areas

A review of existing Ministry of the Environment guidelines on separation distances was carried out and the results of this survey were discussed with the Ministry. Based on these discussions, OWMC decided to adopt a 1 km distance as the radius of a study area for the incinerator and physical/chemical treatment plant.

The technical buffer zone for the landfill (50 m) represents an adequate distance for the detection and correction of leachate migration from the site. In this case, it was found that the standard separation distance of 500 m used by the Ministry was not applicable since it is based on methane generation in sanitary landfills. The 500 m distance was, however, adopted as the study area for the landfill.

A 5 km radius study zone was specified based on air emission criteria under normal conditions. It represents the limit of the area where emissions from the plant might be expected to have any measurable effect on the environment.

Thus, existing land uses and environmental sensitivity were studied within 1 km; and population distribution, agricultural land use and ambient air quality within 5 km.

PREMISES AND POSTULATES

PREMISES

A premise is defined as a condition to the work as specified by OMWC. It may be in the form of a body of data or alternatively a decision made by OMWC. Major premises concerned with this portion of the work are listed below.

- a) OMWC waste inventory data.
- b) Facility arrangement options are limited to five as follows:
 - integrated
 - physical/chemical treatment plant plus incinerator, separate landfill
 - physical/chemical treatment plant plus landfill, separate incinerator
 - incinerator plus landfill, separate physical/chemical treatment plant
 - fully dispersed
- c) Only proven technology to be considered.
- d) No untreated wastes to be landfilled.

- e) UCD waste classification system to be used for waste stream identification.
- f) 300 000 tonnes/year to be the maximum design level for waste input to the facility.
- g) Total solidification to be assumed for the determination of landfill area requirements.
- h) Individual landfill cell volume to be adequate for one year's production from the solidification plant when operating at design rate.

POSTULATES

A postulate is defined as an assumption or a decision made by the Consultant during the course of the work. All postulates were reviewed by OWMC. Major postulates are listed below:

- a) Ontario Regulation 308 was applied both for the method of a calculation and for the contaminant limits.
- b) Threshold limit values (TLV)¹ apply for emission limits in an industrial setting.
- c) Potential sources of emission are located in a rectangle of dimensions 50 m by 150 m within the operations area. This area contains the storage areas for the incinerator and physical/chemical treatment plant in an integrated facility.

- d) Atmospheric stability classes for air dispersion calculations are limited to those specified in Ontario Regulation 308.
- e) The land area adjacent to the plant site is flat. No provision has been made to evaluate the effects of topographic relief for the purposes of establishing buffer zones.
- f) All buffer zones are measured from the point of emission.
- g) In an integrated site, the processing plant is assumed to be located in the centre of the landfill.
- h) The cement/flyash process was used as a viable choice for the OWMC solidification plant.
- i) The breakdown of the OWMC overall waste inventory data was divided into individual UCD classes. This was necessary since the OWMC premise covered only the OWMC overall categories and was not sufficiently detailed at the UCD class level.
- j) Proration of the waste inventory data to levels below 500 000 tonnes/year on a linear basis is valid.

FINDINGS

TECHNICAL BUFFERS

Physical/chemical treatment plant (Rural or Light Industrial Setting)

A technical buffer of 400 m is required to ensure compliance with Ontario Regulation 308 under the abnormal conditions considered.

Incinerator (Rural or Light Industrial Setting)

A technical buffer of 400 m is required to ensure compliance with Ontario Regulation 308 under the abnormal conditions considered.

Landfill

A technical buffer of 50 m is required to provide adequate response time in the event of cell leakage and leachate migration.

Heavy Industrial settings

No buffer is required in a heavy industrial location provided that threshold limit values¹ are the criteria to be met. A buffer zone of 200 m would ensure that no problems were encountered.

Integrated sites

The 400 m buffer zone required for the processing facilities generally is adequate to contain the landfill and its buffer requirements.

STUDY AREAS

A study area of 500 m was accepted around the landfill. This study area should be used to assess the effects of visual and noise impacts associated with the landfill on the community.

A study area of 1000 m was accepted and should be used to assess the impacts associated with the physical/chemical treatment plant and the incinerator on the surrounding community.

A study area of 5000 m was accepted and used to assess the effects of incinerator stack emissions on the community.

SITE AREAS

Areas required for various plant arrangement options located in rural setting are as follows:

-	Separate incinerator	64 ha
-	Separate physical/chemical treatment plant	64 ha
-	Separate landfill	110 ha
-	Incinerator and physical/chemical treatment plant	80 ha
-	Physical/chemical treatment plant and landfill	112 ha
-	Incinerator and landfill	112 ha
-	Integrated facility	112 ha

CHAPTER 1

INTRODUCTION

The Ontario Waste Management Corporation has been given a mandate to design, construct and operate a facility for the management and treatment of special and hazardous wastes. The design and sizing of these facilities must be such as to provide maximum security to the public and the environment while providing adequate operating flexibility and expansion potential.

In developing the Province's facilities for managing special wastes, the OWMC is committed to minimizing risk to human health and impacts on the environment. This commitment is reinforced by the concerns of the public relating to the effects that the facilities may have both on people living or working nearby, and on the existing or future use and enjoyment of adjacent lands.

The step-by-step approach used in the OWMC's site selection process is founded on minimizing human health risks and impacts to the environment. Initially, two zones in the Golden Horseshoe area were selected based on overall proximity to the generators of special wastes and the suitability of geological and hydrogeologic conditions for the natural containment of special wastes, e.g. thick uniform deposits of clay. In the second step, candidate areas were selected in the two zones based on an evaluation of environmental factors (hydrogeology, air dispersion, surface water, transportation) and an overview of land use (agriculture, built-up areas, population density, industrially designated lands and publicly held lands). In summary, based on the most favourable combination of these environmental and land use factors, 20 relatively large candidate areas were selected.

In the third step of the site selection process, a progressively increasing level of detail relating to many environmental, land use and transportation factors was used to select a short list of candidate sites. In essence the third step consisted of three stages:

- Constraint mapping to identify the most suitable site areas within the candidate area.
- Screening of the site areas to identify the most suitable potential sites.
- An initial comparative evaluation of the potential sites to identify the most suitable candidate sites.

In the progressively more detailed analyses carried out in the third step, preliminary sites sizes were estimated for OWMC's facilities. This preliminary sizing of sites recognized that the three major waste treatment and disposal components (incinerator; physical/chemical treatment plant; engineered landfill) each could be on three separate sites, or could be integrated on a single site, or could be arranged in three other facilities combination on two sites, (e.g. the incinerator and physical/chemical treatment plant on one site with a separate landfill site).

Preliminary engineering work indicated that the actual operations area for the facilities could be contained on a relatively small site, e.g. 11 ha (400 m x 275 m) for the incinerator and physical/chemical treatment plant on one site. Further analyses were then undertaken to define the minimum space required beyond this operating area to provide protection against possible adverse

environmental effects and to minimize nuisance from any accidental releases of contaminants. The areas selected provided for the monitoring of such releases. This area immediately adjacent to the operating area has been called a technical buffer.

TECHNICAL BUFFER AND STUDY AREAS

Preliminary estimates suggest a technical buffer of 400 m from the limits of the area of potential emissions in the operations area for the incinerator and/or physical/chemical treatment plant, and 50 m from the edge of the engineered landfill. The 400 m technical buffer zone is considered to be required except in heavy industrial areas where the compatibility of adjacent land uses may permit a smaller buffer zone or no buffer zone.

The site size including the technical buffer is more than seven times larger than the size of the operations area, e.g. 80 ha compared to 11 ha for the incinerator and physical/chemical treatment plant together.

The technical buffer is a level of protection beyond that provided by the best proven technology and the best operating procedures that can be implemented by OWMC.

Further site selection steps aimed at minimizing the potential impacts, including nuisance, on people or land uses nearby to the facilities were incorporated into the third step of the site selection process. These included the study of existing land uses and environmental sensitivity in an area 1000 m from the area of potential emissions in the operations area of the incinerator and physical/chemical treatment plant, and 500 m from the landfill

site. Also, within a 5 km distance of the potential sites of the incinerator and physical/chemical treatment plant, analyses were made of factors such as population distribution, ambient air quality and agricultural land use patterns. A preliminary study of environmental and land use features adjacent to access roads was also undertaken. The results of these environmental and land use analyses were used in comparing the potential candidate sites on the basis of minimizing the potential for impacts within the areas that could be influenced by OWMC facilities.

PURPOSE OF THIS REPORT

The purpose of this report is to set out the process used in late 1982 and 1983 in establishing a preliminary plant design adequate for site selection purposes, and in setting the recommended size of the technical buffer and the study areas beyond the technical buffer which were used in the selection of candidate sites. This report also includes a review of land use compatibility policies and land use control policies in Ontario.

ARRANGEMENT OF THIS REPORT

Subsequent chapters of this report are arranged as follows:

Chapter 2: "Site Sizes, Technical Buffers and Study Areas" presents the sizes of the sites required for the various combinations of facility components together with the required operation areas. The study areas used in the selection of candidate sites area are shown in relation to the required site sizes.

- Chapter 3: "Facility Characteristics and Potential Impacts" presents the findings of the preliminary engineering carried out prior to mid 1983 to define the characteristics of the facilities (e.g. treatment processes, size of operations areas) and describes the potential impacts under normal operating conditions.
- Chapter 4: "Technical Buffers" defines abnormal conditions and emission events used as a basis for determining the technical buffer. Emission criteria and the method of calculating the technical buffer are also presented together with the required technical buffers.
- Chapter 5: "Land Use Compatibility" presents a brief description of existing policy in Ontario and a summary of existing guidelines.

An executive summary is provided at the front of this Report.

CHAPTER 2
SITE SIZES, TECHNICAL BUFFERS AND STUDY AREAS

INTRODUCTION

The OWMC facilities will provide treatment and disposal for liquid industrial and hazardous waste generated in the Province of Ontario.

For purposes of classification, the original OWMC waste inventory was divided into 14 categories and a further series of sub-categories or classes based on the University of California (Davis) (UCD) system. This system was selected by OWMC as the system most closely matching their design requirements.

Special wastes will include a wide range of inorganic and organic wastes in the forms of liquids, sludges, and solids. Existing OWMC estimates of special wastes suggest an initial design capacity of 150 000 tonnes/year with a capability for future expansion to 300 000 tonnes/year. Initially it is anticipated that of 150 000 tonnes/year, 30 000 tonnes/year will be organic wastes and 120 000 tonnes/year will be inorganic wastes.

For the purposes of establishing site sizes and technical buffer zones, it was assumed that the treatment facility would consist of the following:

- an incinerator of the rotary kiln type for the thermal destruction of organic wastes;

- a physical/chemical treatment plant for the treatment of organic and inorganic wastes, including solidification of wastes and/or residues from the inorganic treatment processes;
- an engineered landfill for the containment of treated wastes from the physical/chemical treatment plant and the treated residues from the incinerator.

Preliminary engineering carried out to mid 1983 to arrive at the size of the operations area for the incinerator and/or physical/chemical treatment plant and the size of the engineered landfill was based on the estimated annual quantities of 150 000 and 300 000 tonnes/year. Consideration has also been given to avoiding initial plant overcapacity and ensuring operational flexibility by assuming that the physical/chemical plant would initially process 50 000 tonnes/year based on one 8-hour shift per day, five days per week. Sufficient space has been allowed in the physical/chemical treatment plant operations area to accommodate the ultimate capacity based on three shifts per day. In the preliminary sizing of the operations area for the incinerator, allowance has been made for a continuous three shift per day operation to dispose of 30 000 tonnes/annum, with a duplication of the initial equipment to meet anticipated ultimate requirements.

The size of the engineered landfill has been arrived at based on accommodating solidified wastes resulting from handling a total of 300 000 tonnes/year at the incinerator and physical/chemical treatment plant, assuming that total solidification as discussed in the following section is practised. Variations in the quantities of solidified waste to be landfilled will not have a

significant effect on the size of the landfill site but may change the life of the landfill. The size of the landfill used in this report permits a 20 to 30-year life at 300 000 tonnes/year.

The preliminary analysis used to arrive at the size of the technical buffer for the incinerator and physical/chemical treatment plant reflect the knowledge of the types of wastes and their characteristics expected to be treated by OWMC.

SIZES OF SITE AND TECHNICAL BUFFER

FACILITY ARRANGEMENT OPTIONS

All possible arrangements of the three facility components have been considered in the preliminary sizing of the operations areas and technical buffer zones, as follows:

Based on a qualitative analysis of the potential impacts of the operations of the various facility arrangements, including transportation of raw and processed wastes and treatment chemicals, and an analysis of environmental impacts and a preliminary assessment of capital, operational and transportation costs, the preferred facility arrangements are as follows:

- Integrated: Incinerator, Physical/Chemical
 (See Item 3 - Treatment Plant and Landfill, all at
 Table 1) one location on one site.

- Partially integrated: Incinerator and Physical/Chemical
 (See Item 2.1 - Treatment Plant together on one site,
 Table 1) and the Landfill at a separate site.

TABLE 1**FACILITY ARRANGEMENT OPTIONS,
OPERATIONS AREA AND SITE SIZES**

<u>Description</u>	<u>Size of Operations Area</u>		<u>Size Including Technical Buffer</u>	
	Hectares	Metres	Hectares	Metres
1. <u>Dispersed</u>				
1.1 Separate Incinerator	7	305 x 230	64	800 x 800
1.2 Separate Physical/ Chemical Treatment Plant	10	400 x 250	64	800 x 800
1.3 Separate Landfill	88	1 130 x 775	110	1 230 x 875
2. <u>Partially Integrated</u>				
2.1 Incinerator and Physical/Chemical Treatment Plant (Separate Landfill)	11	400 x 275	80	950 x 850
2.2 Physical-Chemical Treatment Plant and Landfill (Separate Incinerator)	93	930 x 995	112	1 030 x 1 095
2.3 Incinerator and Landfill (Separate Physical/Chemical Treatment Plant)	93	930 x 995	112	1 030 x 1 095
3. <u>Integrated</u>				
Incinerator and Physical/Chemical Treatment Plant and Landfill all on one site	93	930 x 995	112	1 030 x 1 095

NOTE: Templates based on these areas were used to evaluate site size and configuration during the initial site screening and the initial comparative evaluation of the screened sites.

Subsequent discussions of technical buffer zones in this report is limited to these two preferred arrangements.

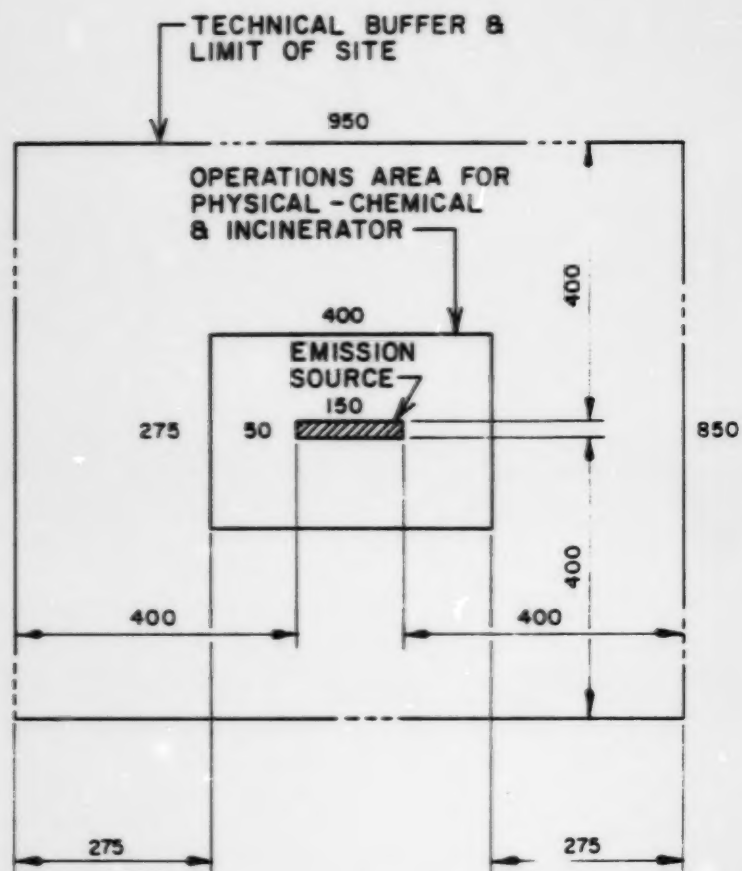
TECHNICAL BUFFER AND SITE SIZE FOR INCINERATOR AND PHYSICAL/CHEMICAL TREATMENT PLANT

The derivation of the technical buffer zones is presented in detail in Chapter 4. In essence, if the incinerator and physical/chemical treatment plant are located in other than a heavy industrial setting, the technical buffer required is 400 m measured from the limits of the emissions area in the operations area. This emissions area is defined as the probable source of accidental gaseous emissions against which the technical buffer zone provides protection for the adjacent land use. The emissions area has been defined as an area of about 150 m by 50 m (0.75 ha) in the centre of the operations area and corresponds to the potential storage area in the preliminary layout. The addition of a 400 m technical buffer in all directions from this area results in a site size of 950 m x 850 m or about 80 ha.

This is illustrated in the following Figure 1.

TECHNICAL BUFFER FOR LANDFILL

The derivation of the 50 m technical buffer for the landfill is presented in Chapter 4. This technical buffer is the minimum distance from the edge of the landfilled area to the property limit of the landfill site and is illustrated in the following Figure 2.



NOTE: ALL DIMENSIONS IN METRES

TECHNICAL BUFFER FOR FULLY INTEGRATED FACILITY

If the incinerator and physical/chemical treatment plant are at the same location as the landfill, they can be arranged on the site such that their 400 m technical buffer is included in the area occupied by the landfill and its 50 m technical buffer.

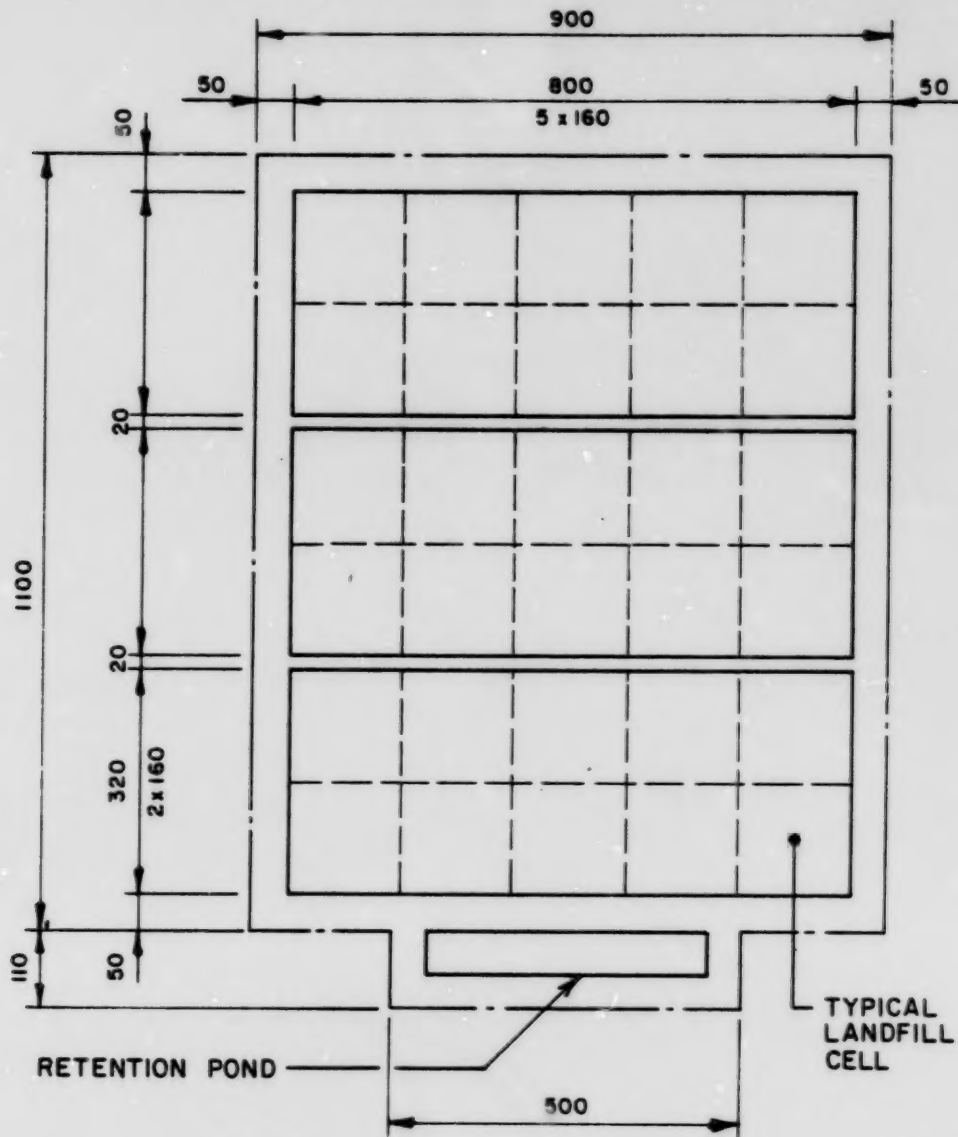
This arrangement of the fully integrated facility and the technical buffer zones is diagrammatically illustrated on the following Figure 3.

STUDY AREAS USED IN SITE SELECTION

INCINERATOR AND PHYSICAL/CHEMICAL TREATMENT PLANT

The rationale for the 1 km and 5 km study limits used in the screening and initial comparative evaluation to arrive at the candidate sites is presented in Chapter 4 of this report.

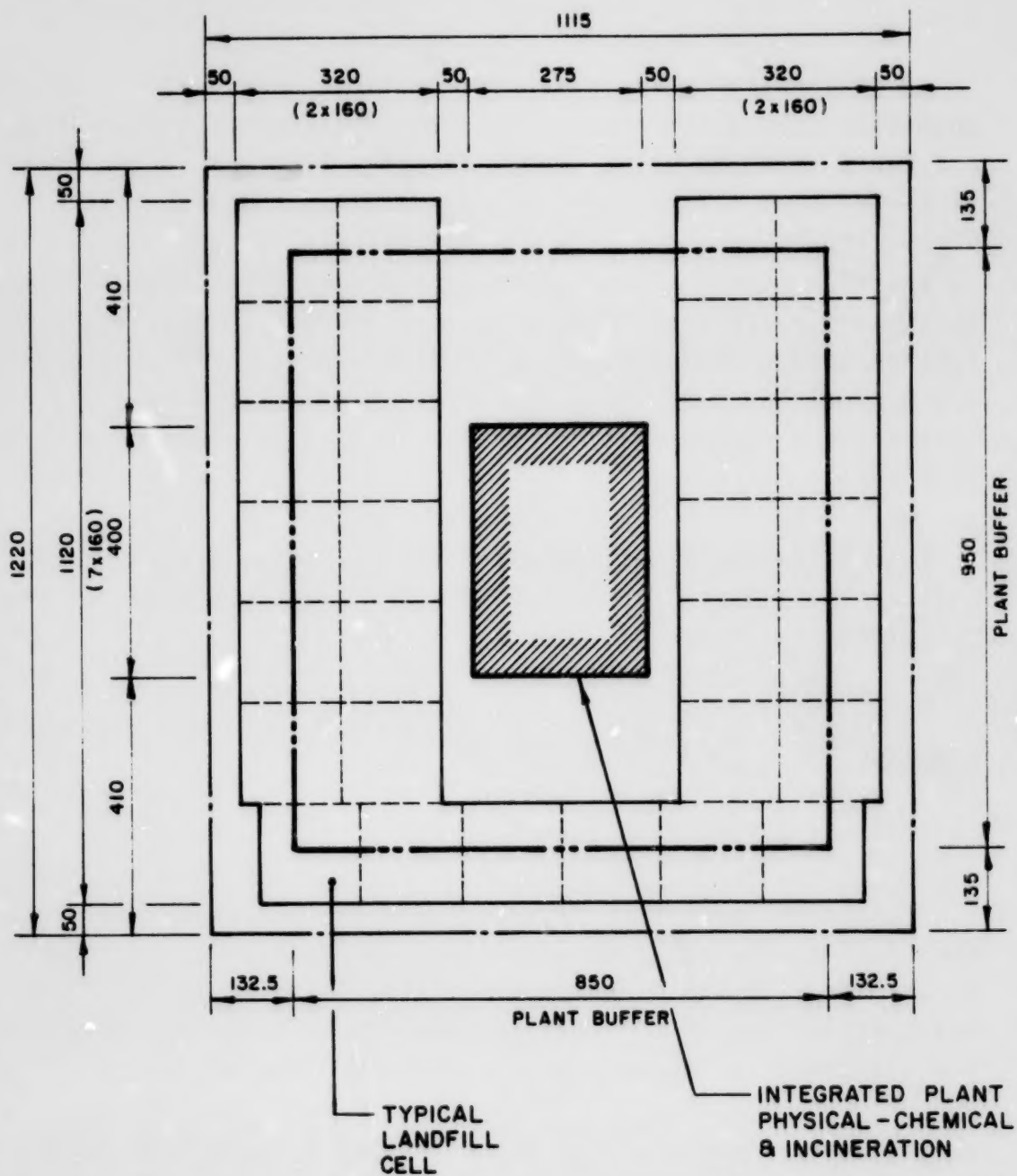
The 5 km study limit is based on the area of influence for emissions from the incinerator stack based on preliminary studies by Ontario Research Foundation (Ref: Gartner Lee Associates Limited³). Contaminant concentration and depositions at ground level from stack emissions will be extremely low and well within acceptable or regulatory limits as discussed in Chapter 4 of this report. The 5 km limit, nevertheless, provided a reasonable study area for the comparison of potential sites with each other in terms of population centres, agricultural land uses, and environmentally sensitive areas, etc.



NOTE: ALL DEMENSIONS IN METRES

TYPICAL
LANDFILL
ARRANGEMENT

FIG.
2



NOTE: ALL DIMENSIONS IN METRES

DILLON

**INTEGRATED SITE
LAYOUT WITH
BUFFER ZONES**

FIG.
3

A distance of 1 km is relatively large when compared to the guideline separation distances of 90 to 300 m for medium industry and "more than 300 m" for heavy industry included in the Ministry of Environment's Policy Manual for Land Use Compatibility (Ref: MOE⁵). The issue of land use compatibility is more applicable to the siting of the incinerator and physical/chemical treatment plant in a rural area than in a heavy industrial area and is further discussed in Chapter 6 of this report. The 1 km distance was accepted by OMMC after discussion and review. This distance represents an appropriate dimension of a study area for this type of plant.

The relationship of the site size including the technical buffer zone and the 1 km and 5 km study limits is shown on the following Figure 4.

LANDFILL

The rationale for the 500 m study limit outside the site of the landfill is given in Chapter 5.

The 500 m separation distance between the property limit of the landfill and adjacent sensitive land uses (e.g. residences) in a rural setting was based on minimizing nuisance due to incompatible land use. It is not intended to serve as a safety separation as would be the case with a sanitary landfill.

The relationship of the landfill and its technical buffer zone and study area is shown on the following Figure 5.

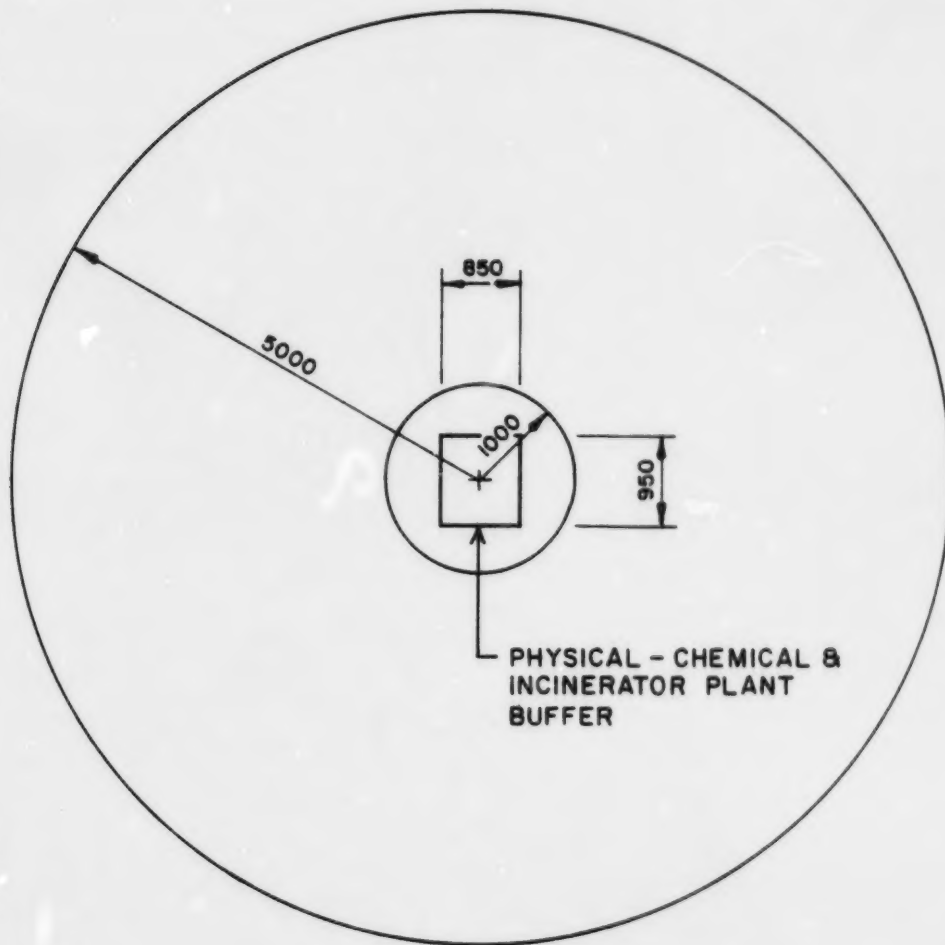
FULLY INTEGRATED FACILITY

The study areas for the incinerator, physical/chemical treatment plant and landfill on a single site are a combination of those for the component facilities, and are shown on the following Figures 4 and 5.

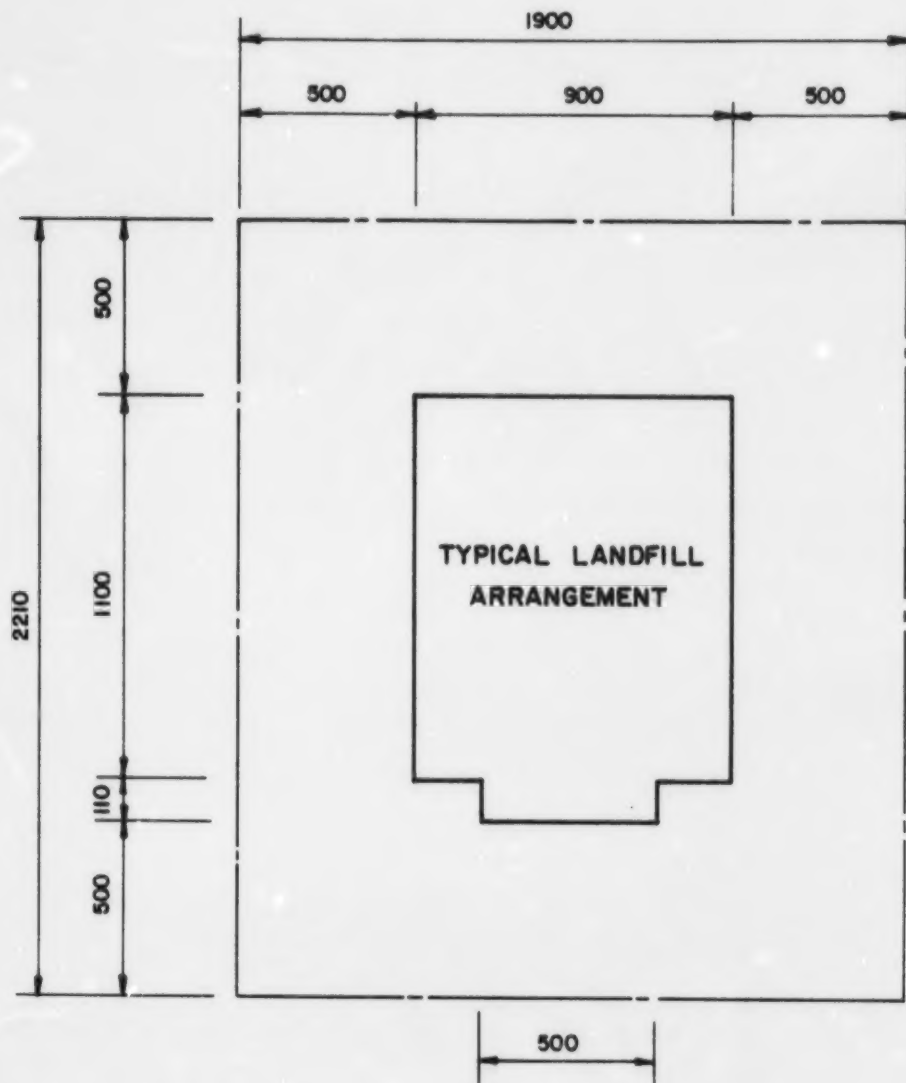
ACTUAL SIZE OF CANDIDATE SITES

The minimum required site size for the facilities, if located in a rural setting, amounts to the operations area plus the technical buffer.

The sizes of the candidate sites identified in Phase 3 of the facilities development process may be larger than the minimum size because of practical factors such as existing property ownership boundaries and surface drainage patterns. Site sizes and buffers are subject to further study in Phase 4 and will vary based on the characteristics of the site, of the nearby land uses and of the facilities.



NOTE: ALL DIMENSIONS IN METRES



NOTE ALL DIMENSIONS IN METRES

CHAPTER 3

FACILITY CHARACTERISTICS AND POTENTIAL IMPACTS

OBJECTIVES FOR DESIGN AND OPERATION

GENERAL

This chapter is intended to provide sufficient process description and detail to allow an understanding of the unit processes and unit operations involved. Without such background data, it would be difficult to understand the emission scenarios developed in Chapter 4.

INTRODUCTION

The overall goals of the OWMC in facilities development are as follows in order of priority:

- minimize risk to human health
- minimize impacts to the environment
- minimize financial costs to OWMC and to the people of Ontario

These goals dictate the objectives for the design and operation of the facilities which can be summarized as follows:

- Use of best proven technology for the safe and economical treatment and disposal of special wastes to minimize risk to health and environment.

- Use of the best proven systems for the control of waste transportation, waste handling, waste storage and waste processing in order to minimize risks of accidents and thereby minimize risk to workers, the public and the environment.
- Use of the best proven technology for the control and monitoring of emissions from the facilities to ensure that such emissions are safe and also do not pose a nuisance to nearby landowners.
- Use of an emergency response contingency plan and trained staff to counteract immediately the effects of any accident in the handling, storage or processing of wastes.
- Striving to confine the impacts of the operations of the facilities within the operations area for normal conditions, and providing a technical buffer to safely contain the effects of an abnormal emission event, and to permit a space within the plant boundary in which monitoring and remedial actions can occur.

EMISSIONS AND IMPACTS

Emissions and impacts from the facilities can be viewed as those which could pose a threat to the health or safety of humans, especially workers, or to the environment; or those which could constitute a nuisance to nearby land users.

These emissions and impacts further should be viewed in relation to the normal operating conditions and short-term abnormal conditions. In either situation, the health and safety of the

workers at the facilities and the public at large will be of paramount concern at all times to OWMC. Operations staff will normally be working in the operations area. Thus, if conditions in the operations area are safe and pose no risk to the health of the staff, it is reasonable to conclude that conditions outside the operations area, at the limit of the technical buffer, will not threaten abutting land users. This is not necessarily the case in relation to the dispersion of emissions from a tall incinerator stack, which may result in the maximum ground level concentrations being well outside the operations area.

The potential emissions and impacts from the component facilities are discussed in the following sections.

PHYSICAL/CHEMICAL TREATMENT PLANT

TYPES OF WASTES

The types of wastes for the physical/chemical treatment plant will be mostly inorganic in nature. Details of wastes, based on available inventory data for Ontario, are given in other reports (Proctor & Redfern, 1983²; OWMC Phases 1 and 2, Appendix A). Examples of the types of inorganic wastes to be treated at the physical/chemical treatment plant are:

- acid wastes
- alkaline wastes
- neutral wastes
- chromium wastes
- sulphide wastes
- cyanide wastes

The liquid acid, base and neutral wastes may contain a wide range of metals, such as mercury, lead, zinc, nickel, copper and arsenic depending upon the industrial process generating the wastes. In addition to liquid wastes, the physical/chemical treatment plant will receive sludges and slurries which are the residues from on-site treatment facilities at some industries. Solid inorganic wastes may also be received.

With the incinerator and the physical/chemical treatment plant located on the same site, some organic chemicals will also receive treatment in the physical/chemical treatment plant. For example, oil/water mixtures will be treated to separate the oil from the water prior to incineration of the oil; latex wastes may be treated to separate the latex from water by emulsion breaking prior to incineration of the latex. The water from these organic waste streams would be given further treatment in the physical/chemical treatment plant.

TREATMENT PROCESSES AND ULTIMATE DISPOSAL

The actual treatment processes employed at the physical/chemical treatment plant are subject to refinement in future engineering design as data on special waste quantities and characteristics are in turn refined. Preliminary studies of the treatment processes were reported by Proctor & Redfern, (1983²). These preliminary analyses were based on proven physical/chemical processes which have been safely and effectively used in numerous industrial and waste treatment applications.

The physical/chemical treatment plant, including the solidification section, does not directly provide a means of disposing of the contaminants contained in or removed from wastes. Rather, the physical chemical treatment plant pretreats wastes so that contaminants can be safely landfilled after solidification, or so that the contaminants can be incinerated safely and economically.

If total solidification is not employed, the physical/chemical treatment plant will produce a liquid effluent comprising most of the water originally contained in the wastes. The liquid effluent will be treated and polished in the physical/chemical treatment plant to ensure that it is safe for discharge to a receiving water body either directly or via a municipal sewage treatment plant. Liquid effluent disposal, if required, will be subject to much further detailed study in terms of potential environmental impacts but does not directly affect the technical buffer for the physical/chemical treatment plant, and thus is not considered further in this report.

PHYSICAL/CHEMICAL TREATMENT PROCESSES

GENERAL

Preliminary engineering design of physical/chemical treatment processes and operations was undertaken by M.M. Dillon in early 1983 in order to develop plant layouts and site sizes. The waste inventory data and waste characteristics were those available in mid 1983. The treatment processes and operations defined in this preliminary work were based on the concept that the physical/chemical treatment plant might stand alone, independent of any

solidification operations. This premise has now been modified with the recognition that at least some degree of solidification will be applied to any waste prior to placement in the engineered landfill.

The treatment processes and operations proposed in the early work can be divided into two basic physical/chemical treatment plant areas, the inorganic treatment train and the organic separation train. The former area is concerned with the treatment of metals and their removal and with the treatment and elimination of toxic anions such as sulphide and cyanide. The organic separation train functions to separate organic materials from water. The separated organics would then be transferred to the incinerator for final destruction.

LEVEL OF TECHNOLOGY

The basic treatment steps proposed for both the inorganic and the organic trains can be classed as fully proven technology which is in widespread use today. Development of these processes and operations is fully established and recognized as commercially viable.

The final effluent polishing steps (if required) are chosen from unit processes which are somewhat more recent in development and which represent current best available technology. Development work on these processes is continuing.

AQUEOUS EFFLUENT

At the present time, most plants similar to the physical/chemical treatment plant considered in this report produce an aqueous

effluent. The quality of this effluent depends on the processes used and the efficiency and care with which the plant is operated. Modern developments appear to offer the opportunity for operation with no aqueous effluent. In effect, these developments modify the physical/chemical treatment processes to produce a solidified product rather than an aqueous effluent. If no such aqueous effluent is produced, the process is referred to as "Total Solidification", and this terminology is used in this report.

PARTIAL SOLIDIFICATION AND EFFLUENT POLISHING

Unless solidification is employed, there will necessarily be an aqueous effluent from the physical/chemical treatment plant. This effluent would have to meet the criteria set by the Ministry of the Environment.

As with air emission standards, the Ontario regulations are concerned with stream quality after mixing and not directly with effluent quality at the point of discharge. Thus, the criteria take precedent over the suggested effluent limits. It is therefore necessary to know the characteristics of the receiving body of water into which discharge is proposed before a final conclusion can be reached on the degree of effluent polishing necessary.

It was concluded that the basic treatment steps used in physical/chemical treatment should be supplemented by a series of polishing steps in order to improve effluent quality. This is applicable only to the partial solidification option.

OIL/WATER SEPARATION TRAIN

This section of the plant would receive organic based wastes, such as oil/water mixtures and latex wastes. The plant would serve to separate waste hydrocarbons from water.

The basic unit operations included in this train are standard in the waste treatment and chemical processing industries and consist of gravity oil separation, emulsion breaking and dissolved air flotation, and filtration. A vacuum filter is proposed for the last operation to further reduce the liquid content of sludges.

The waste organics separated in the above processes in the form of liquid, such as waste oil, or froth, sludge or filtercake would be incinerated. The aqueous effluent from the above processes would be either further treated by polishing prior to discharge with the partial solidification option; or solidified with the total solidification option.

METAL TREATMENT TRAIN

Inorganic liquid wastes treated in this treatment train will consist of acidic, basic, or neutral wastes contaminated with a wide range of metals in the form of heavy metal solutions. Anion wastes, such as cyanides and sulphides, will also be received.

The basic treatment process specified for the removal of contaminant metals is to chemically produce an insoluble metallic salt as a precipitate which can then be removed by a physical process such as settling in a clarifier. A proven and economic precipitation method for many metals is to add lime so that insoluble metallic hydroxides are formed. Many metals which do not form highly insoluble hydroxides will form insoluble sulphides if a chemical such as sodium sulphide is added.

Subsequent to the precipitation stage, separation of the precipitate is encouraged and accelerated by flocculation and settling in a clarifier and/or by vacuum filtration.

Some heavy metal solutions such as those containing mercury, chromium and arsenic require pretreatment to render them safe or amenable to the subsequent formation and precipitation of insoluble hydroxides or sulphides.

A brief description of the metal treatment train processes is as follows:

- Pretreatment

Mercury wastes will be pretreated by oxidation using hypochlorite in an alkaline solution. Mercury in the oxidized (mercuric) form will subsequently be precipitated as a hydroxide.

Arsenic wastes will be pretreated by the addition of ferrous sulphate, to precipitate a stable iron complex at neutral pH in the subsequent lime precipitation process. Arsenic will also form an insoluble sulphide, thus sulphide precipitation will follow lime precipitation as a polishing step if required.

Chromium wastes will be pretreated to reduce the toxic hexavalent form to the trivalent form. The reduction is carried out using ferrous sulphate in acidic conditions. Subsequent treatment with lime will precipitate the trivalent chromium as an insoluble hydroxide. This pretreatment to the lower oxidation (trivalent) state is necessary because chromium in its oxidized (hexavalent) form is highly toxic and its compounds are generally water soluble.

Cyanide wastes will be pretreated by oxidation using chlorine or hypochlorite in alkaline conditions. Provision for long treatment times and large excesses of reagent is necessary to ensure destruction of metal complexed cyanides. This pretreatment is necessary because cyanide is highly toxic and when complexed with heavy metals causes difficulties in the precipitation of these metals. Pretreatment of cyanide proceeds in a two stage reaction: first to the less toxic cyanate and then potentially to carbon dioxide and nitrogen. Subsequent treatment in the lime precipitation and sulphide polishing stages (if any) will remove the metals associated with the cyanides.

Special pretreatment is indicated for materials other than those indicated above. This will include pretreatment to eliminate complexing agents such as ammonia or the destruction of traces of hydrocarbons.

Subsequent to pretreatment, all of the above wastes streams will be treated by neutralization and precipitation using lime to precipitate insoluble metallic hydroxides. Following clarification to settle out the hydroxide sludges, the clarifier effluent may be further polished by sulphide treatment.

SULPHIDE TREATMENT

An aqueous effluent from the hydroxide precipitation and clarification steps may meet effluent discharge criteria for some heavy metals without further treatment. If further treatment of metals is required, sulphide treatment would be provided by the addition of sodium sulphide. Precipitation of metals in the form of insoluble sulphides will occur.

Wastes containing metals which do not form insoluble hydroxides but which do form insoluble sulphides would be given sulphide treatment.

EFFLUENT POLISHING

Some liquid effluent from the oil/water separation train and the metal treatment train may require some additional treatment in order to ensure absolute compliance with provincial effluent discharge criteria. This effluent polishing may take several forms and choices are available from:

- Biological oxidation
- Chemical oxidation using ozone
- Carbon adsorption
- Ultrafiltration
- Reverse osmosis
- Electrodialysis.

Ultrafiltration, for example, would be suitable for polishing the liquid effluent from the sulphide treatment step of the metal removals train. Chemical oxidation and carbon adsorption would be suitable for the removal of trace organics from the effluent of the oil/water separation train.

TREATMENT OF WATER CONTAMINATED ON-SITE

In addition to liquid wastes received at the facilities, testing and treatment will be provided for other water contaminated on-site. Where possible this water will be recycled for use in the processing operations to minimize potable water consumption at the facilities. Treatment of contaminated water is proposed as follows:

Site Drainage from some areas of the site e.g. truck unloading bays, could be contaminated. This will be collected and tested. Possible uses are as make-up water in the solidification process or quench water for the incinerator. Physical/chemical treatment will be provided as required.

Truck Washing will be carried out, as required, for trucks delivering wastes to site and for on-site vehicles. This water will be collected and tested. Some recycling of truck washing water may be feasible. Other possible uses and treatment are as stated for site drainage.

Landfill Leachate will be collected and tested. The leachate is expected to be of good quality and small in quantity because of the leaching resistance characteristics of the solidified material in the landfill and the intended construction and operation to minimize the entrance of water to the landfill. Liquid leachate can be used as make-up water for solidification or, if contaminated, given further physical/chemical treatment.

Incinerator Scrubber Effluent will be generated if a wet scrubbing system is used. This effluent will be contained and given physical/chemical treatment or solidified.

SOLIDIFICATION

SOLIDIFICATION PROCESS

Solidification of wastes or treatment residues is a physical/chemical process which results in a product suitable for disposal in an engineered landfill. The objective is to produce a

solidified material which is safe and easy to handle and is inoffensive in appearance and odour, and which has low permeability which restricts leaching of contaminants from the solidified material.

In essence, the proven solidification processes available at present are cement-based; silicate-based; or lime-based, and chemically bind the wastes with the solidification reagent. Two examples are:

- The Stablex "Sealosafe" process which uses portland cement and fly ash as reagents to fix contaminants in an aluminosilicate matrix in the form of a rock-like solid.
- The Browning Ferris Industries "Liqwacon" process which uses cement kiln dust as a reagent to fix such contaminants as silicates and hydroxides in a low permeability monolithic mass formed by compaction of the granular solidified product.

Depending upon the type of solidification process eventually chosen by the Corporation, reagents such as portland cement, fly ash, cement kiln dust, lime or gypsum will have to be transported to and stored and handled on the site of the physical/chemical plant.

PARTIAL AND TOTAL SOLIDIFICATION

Partial and total solidification refer to the portion of the incoming liquid wastes or liquid effluent from the other physical/chemical treatment processes that is solidified and disposed of in the engineered landfill.

Total solidification means that no aqueous effluent will leave the physical/chemical treatment plant. Liquid wastes would be pretreated using other physical/chemical processes and then fed to the solidification portion of the plant. Liquid effluents from the scrubber of the incinerator and contaminated drainage from the facilities would be similarly handled. In effect the only water leaving the site would be clean surface water drainage.

Partial solidification means that an aqueous effluent would be discharged from the physical/chemical plant and solidification would be limited to the treatment of residues (sludges, slurries and filter cakes) from the physical/chemical treatment processes plus solid inorganic wastes and fly ash from the incinerator scrubber. The aqueous effluent from the physical/chemical treatment plant would be polished, as required, by further treatment prior to discharge, directly (or indirectly via a municipal sewage treatment plant) to a receiving water body.

In comparison to partial solidification, the total solidification concept produces a larger volume for landfilling and also requires that a greater volume of solidification reagents be brought to the physical/chemical plant treatment site. Total solidification, however, does avoid an aqueous effluent.

EFFECTS OF SOLIDIFICATION ON OTHER PHYSICAL CHEMICAL TREATMENT PROCESSES

The physical/chemical treatment process described in the foregoing is based on cleaning the water content of liquid wastes and discharging it as an aqueous effluent. This treatment produces organic residues (e.g. oil and oily sludge) for incineration, and inorganic residues (e.g. hydroxide and sulphide sludges and filter

cake) for solidification. In effect, the processes as described, represent the means of minimizing the amount of waste to be solidified and disposed of in the engineered landfill.

Depending upon the actual solidification process selected, the physical/chemical treatment processes may vary. Regardless of the actual solidification process selected, it is possible to further reduce the amount of aqueous effluent by increasing the solidification to include some or all of the liquid effluent in addition to the treatment residues. These variants of the partial solidification scheme may require modification of the physical/chemical processes and operations selected. For example, total solidification of liquid wastes would permit elimination of the sulphide treatment stage as a polishing step. At present, however, the exact modifications to the physical/chemical processes for various degrees of solidification cannot be identified. The pretreatment of mercury, cyanide, chromium and arsenic wastes will remain in any solidification scheme, and it is probable that lime neutralization and precipitation will also be employed.

If total solidification is employed, thereby eliminating the aqueous effluent, the effluent polishing stage would obviously not be required.

DEVELOPMENT OF SOLIDIFICATION PROCESS ADDITIVE RATIOS AND VOLUMES

The actual volume of solidified material sent to the landfill depends on the following factors:

- actual process utilized
- additive ratio used to achieve solidification
- bulk density of solidified product
- choice of partial or total solidification as a basic process option

Two processes were considered during the preliminary design work covered by this report. These utilized cement kiln dust and a mixture of cement and flyash as alternative solidification additives. Additive ratios were 2.5:1 (tonnes additive per tonne waste) for cement kiln dust and a range of 0.6:1 to 2.05:1 for cement/flyash.

The cement kiln dust process was dropped from consideration because of poor comparative physical characteristics of the solidified product and excessive product volume.

The additive ratios for cement/flyash were reduced to a range of 0.6:1 to 1.0:1 based on laboratory work carried out by M.M. Dillon to evaluate solidified product characteristics. It is the latter range of additive ratios that were used in determining the landfill and site sizes used in the Phase 3 site evaluation.

CHARACTERISTICS OF THE PHYSICAL/CHEMICAL TREATMENT PLANT

CHARACTERISTICS

The operations area of the physical/chemical treatment plant will consist of the processing facilities; waste storage facilities including tanks for liquid wastes and sludges and areas for drummed wastes; and storage facilities for treatment chemicals,

including bulk storage of solidification reagents such as cement. Weigh scales and scale house, laboratory facilities for waste analysis, process control and environmental monitoring will also be provided together with maintenance workshops, offices, changing rooms with showers; and other staff facilities. Truck washing facilities will also be provided.

It is envisaged that the waste storage and processing operations will take place under cover in a series of buildings. Treatment chemicals will also be stored in other parts of the building. Bulk storage of reagents (e.g. cement) for the solidification process would be in silos adjacent to or incorporated into the building. In effect, wastes to be treated at the physical/chemical treatment plant, together with the treatment operations, will be housed in buildings which will be ventilated to the atmosphere via the buildings' ventilation systems. Some storage tanks may vent directly to the atmosphere via vent stacks.

Access within the site of the physical/chemical treatment plant will be via paved areas with appropriate drainage controls to avoid contamination of clean surface drainage and the migration of contamination off-site. Areas of the site used for sampling of incoming wastes and unloading of trucks will have special attention for the avoidance and containment of spills. All waste and storage tanks will also have external containment to avoid the migration of accidental spills.

During normal operations the physical/chemical treatment plant will receive wastes via trucks, which will travel over controlled paved areas within the site. Initially the plant will operate for eight hours/day, five days/week. Ultimately three

8-hour shifts/day, seven days per week, may be required for processing operations. It is envisaged that the physical/chemical treatment plant will have an appearance similar to that of a modern warehouse with office buildings and with the addition of reagent silos close to the warehouse.

POTENTIAL EMISSIONS AND IMPACTS

Sampling, unloading and storage of wastes will be carefully controlled to minimize release of waste in any form to the environment. The venting of storage tanks directly to the atmosphere will occur and will be subject to appropriate controls. Processing of the wastes in the physical/chemical treatment plant, including solidification, will take place in buildings with the appropriate ventilation to protect workers health and safety. Thus under normal operating conditions, emissions from the physical/chemical treatment processes to the atmosphere will be controlled by collection and cleaning in the building ventilation system. The exhaust system will include odour and dust control systems.

Fugitive emissions such as vapor from tank venting or dust from unloading operations will normally be in very small quantities. Fugitive emissions such as dust from the transport of wastes within the site will be minimized by the use of paved areas and good housekeeping to avoid accumulation of dust in these areas.

It is likely that the most significant impacts during normal operation of the physical/chemical treatment plant will be the

noise of equipment such as ventilating fans and transport trucks. Other process equipment will be housed and noise will be attenuated as necessary in the building design.

Lighting of the operations area will be required during the night hours for site safety and security. Lighting will be designed to satisfy these requirements while minimizing off-site nuisance.

A preliminary assessment of the size of the physical/chemical treatment plant and incinerator has shown that the operations area can be accommodated on 11 ha site (400 m by 275 m). This operations area will contain all the storage and processing facilities together with the administrative and laboratory areas, and parking and turning areas for trucks. Fencing of this area is envisaged for security purposes with exterior landscaping in the technical buffer.

In the technical approach to deriving buffer zones, it was concluded that normal operating conditions at the physical/chemical treatment plant did not represent the worst case. Thus abnormal operating conditions involving unforeseen events were considered together with their potential emissions in determining the extent of the technical buffer.

INCINERATOR

TYPES OF WASTES

The types of wastes for destruction in the incinerator will be organic in nature. Details of wastes, based on available inventory data for Ontario, are given in other reports (see References 2, 9, 10). Examples of the types of organic wastes to be destroyed at the incinerator are:

- organic sludges and still bottoms
- solvents and organic solutions
- oils and greases
- organic and oil residuals
- miscellaneous chemicals and products
- paint and organic residuals
- pesticide and herbicide wastes
- oil/water mixtures including oily emulsions.

The last category will generally be treated at the physical/chemical treatment plant to separate the oil for incineration. The special organic wastes for incineration will be in the form of liquids, sludges, pastes and solids. Waste liquids and sludges may be received in bulk in tank trucks or tank trailers or in drums; solid wastes may be received in drums or by dump or lugger type trucks.

WASTE INCINERATION AND ULTIMATE DISPOSAL

Incineration

The physical components of the incinerator facility will be:

- storage facilities for the incoming wastes including unheated tanks for the storage of liquid hydrocarbon wastes;
- waste handling system for mixing and blending wastes to ensure optimum feeding of the incinerator based on safety and performance;

- incineration components consisting of the rotary kiln (primary combustion chamber) and the after-burner (secondary combustion chamber);
- air pollution control system consisting of electrostatic precipitators and scrubbers to clean the exhaust gases before emission to the atmosphere via the stack;
- water pollution control system to treat water used in quenching or scrubbing. (This system will be incorporated into the physical/chemical plant.)

Details of existing rotary kiln incinerators are given in the report "European Tour Report".¹⁰

Incineration is a proven, safe method of destroying hazardous and toxic wastes. Liquid and solid hydrocarbon wastes are converted by intense heat under controlled conditions to gases leaving only the incombustible inorganics as slag in the rotary kiln or as ash from the flue gas cleaning system. Toxic properties of the wastes are destroyed by changing the structure of organic molecules through oxidation and high temperature.

In essence organic wastes are converted into gases which, after cleaning, are emitted to the atmosphere via a stack. Incombustible residues from the wastes are collected in the form of slag and ash which, after solidification are disposed of in the engineered landfill. Process water used in quenching or scrubbing is given physical/chemical treatment and re-used as process water for the incinerator or for solidification or discharged as a clean aqueous effluent.

The principal concern with the incinerator in terms of potential environmental impact is the quality of the gas leaving the incinerator stack and dispersed in the atmosphere.

EMISSIONS FROM THE INCINERATOR STACK

Two-stage high temperature incineration is carried out at temperatures up to 1400°C in the rotary kiln and in the afterburner. At these temperatures, complex organic contaminants, even in low initial concentrations, are destroyed at efficiencies of 99.98% or better.⁶ Hydrocarbons incinerated with air are converted to their original constituents in gaseous forms such as water vapour, carbon dioxide, nitrogen, and sulphur or nitrogen oxides. The combustion of hydrocarbon wastes containing chlorine will produce hydrogen chloride. Heavy metals which are present may evaporate at high temperature and become metal in gaseous form or may form chlorides, oxides or other salts in gaseous form. Examples of such heavy metals are cadmium, zinc, lead, chromium, copper and vanadium. In addition to the above gases, the gas from the afterburner will contain small particles of ash and incombustible inorganics.

The incinerator will be designed and operated to optimize the combustion conditions to ensure high level destruction efficiencies within the kiln and afterburner. This will include laboratory testing of wastes prior to incineration; blending of wastes for optimum combustion; and continuous monitoring and control of the combustion and air pollution control processes. With a high level of destruction efficiencies, 99.98% or better, the emission of uncombusted or partially combusted organic compounds will not pose a problem. Gas entering the air pollution clean-up train (electrostatic precipitator and scrubber) will consist of combustion products and particulate matter. Particulate matter will consist of particles of ash and inorganics varying in size from a

sand grain to less than a micron. Most of these particles will be removed from the flue gas by the electrostatic precipitator and the scrubber. Provision will be made, if required, for removing submicron particles of heavy metal oxides and chlorides or other salts by aerosol separation.

Combustion products will consist mainly of nitrogen and oxygen, (derived from the combustion air); water vapour (derived as a combustion product from the wastes and the supplementary fuel); and carbon dioxide. An extremely small portion of the combustion products (less than 0.2% by volume) will be in the form of carbon monoxide, sulphur dioxide, hydrogen chloride, nitrogen oxides and other combustion products. Most of the sulphur dioxide and hydrogen chloride will be removed from the flue gas by caustic scrubbing. Nitrogen oxides are not as easily controlled by existing scrubbing technology and will be the subject of further detailed study.

In summary, the gas leaving the incinerator stack after scrubbing will consist mainly of nitrogen, oxygen, water vapour and carbon dioxide, which are odourless and non-toxic, and not considered to be pollutants. The stack gas will also contain small amounts of pollutants such as sulphur dioxide, hydrogen chloride, nitrogen oxide and carbon monoxide, and possibly small amounts of particulates and other combustion products passing through the air-pollution control train. The concentration of these pollutants will meet or be better than permissible concentrations as regulated by the Ontario Ministry of the Environment in terms of the concentration at the point of impingement of the emissions from the stack.

The actual composition of the stack gas will depend on the wastes being incinerated, the actual combustion conditions, and the type and performance of the air pollution control equipment.

The dispersion of the stack gas in the atmosphere and the point of impingement at ground level will be a function of the stack height, exit velocity from the stack and prevailing meteorological conditions.

CHARACTERISTICS OF THE INCINERATOR

The incineration complex will consist of storage facilities for liquid and solid wastes suitable for incineration, blending tanks for mixing wastes, fuel oil tanks if natural gas is not used as an auxiliary fuel, and the incinerator itself together with its flue gas cleaning system. Heat recovery and power generation equipment may also be included to make use of the heat produced in incinerating wastes. Laboratory, administrative and maintenance facilities will be provided in combination with those of the physical/chemical treatment plant.

Wastes for incineration will be predominantly organic in nature and will include relatively volatile hydrocarbon compounds. Fire protection will be a major factor in the design and operation of the storage and handling systems for these wastes. Storage of liquid wastes having low freezing points will be in unheated tanks located in a tank farm with properly engineered containment. No wastes will be stored under pressure and all tanks will be vented to the atmosphere via properly designed vents including flame arrestors. Flare stacks will also be considered for the venting of some tanks.

All areas of the site travelled by trucks will be paved and drained. All unloading areas will be paved and curbed and drained to minimize the risk of the migration of spills.

Fugitive emissions under normal operations will be minor and will include vapour from tank vents and dust from truck traffic. The principal emission under normal operation of the incinerator will be the flue gas leaving the incinerator stack after cleaning. The other emissions of concern will be noise from the incinerator operation, and other operating equipment including trucks, and lighting required for site security and safety.

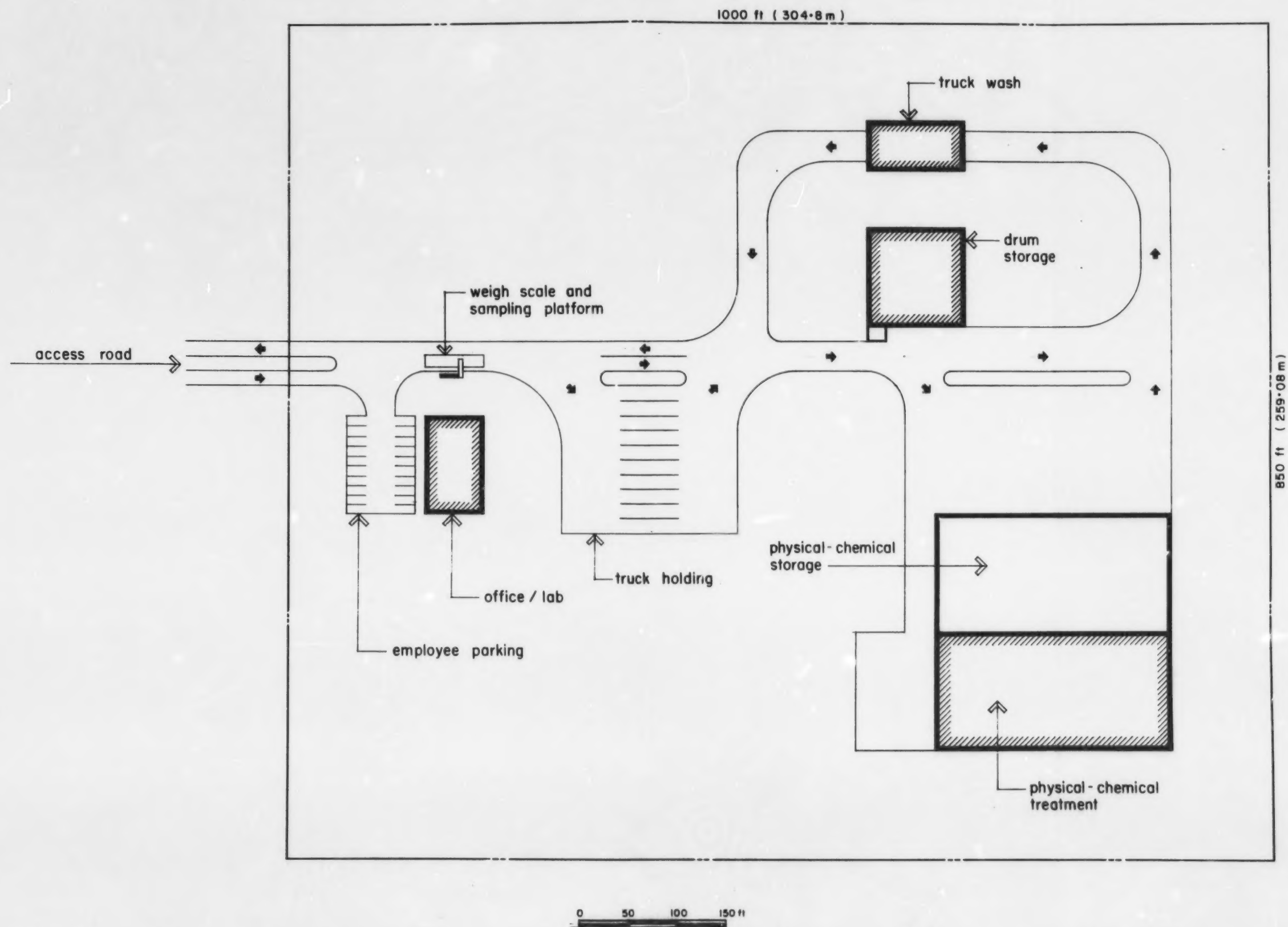
Normal operations at the incinerator are similar to those of a heavy industry in terms of potential nuisance impacts from noise and odour. These potential impacts under normal operating conditions are not significant in relation to those which could occur under abnormal emergency conditions, such as a fire or accidental equipment failure. Thus the approach to determining the technical buffer was based on considering potential impacts from these abnormal conditions. Impacts from normal conditions were then reviewed in the context of the technical buffer so defined.

The operations area of incinerator and physical/chemical treatment plant can be accommodated in an area of 11 ha (400 m x 275 m).

ENGINEERED LANDFILL

TYPES OF WASTES

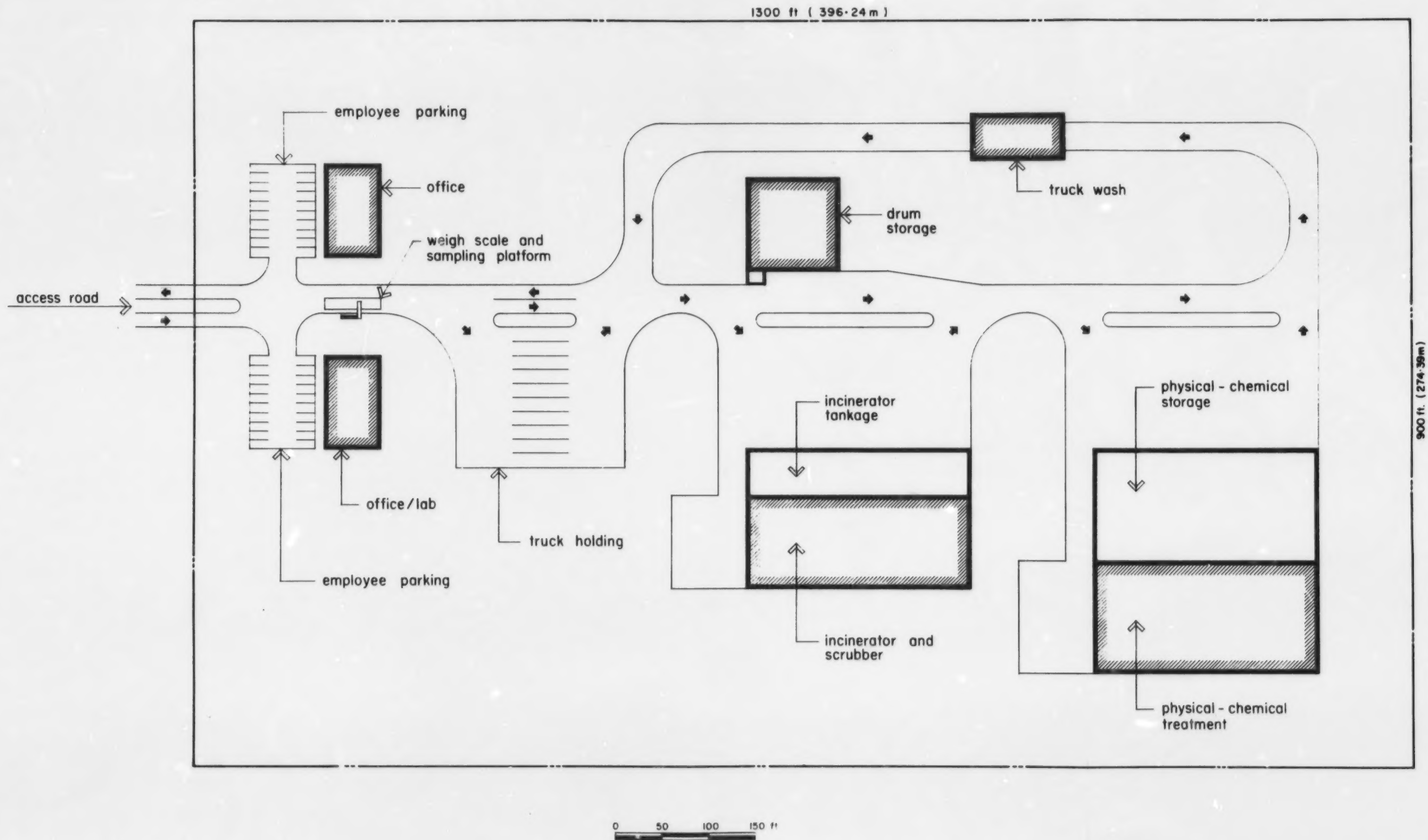
The engineered landfill will receive only treated or solidified wastes and no wastes will be landfilled without such treatment.



0 50 100 150 ft

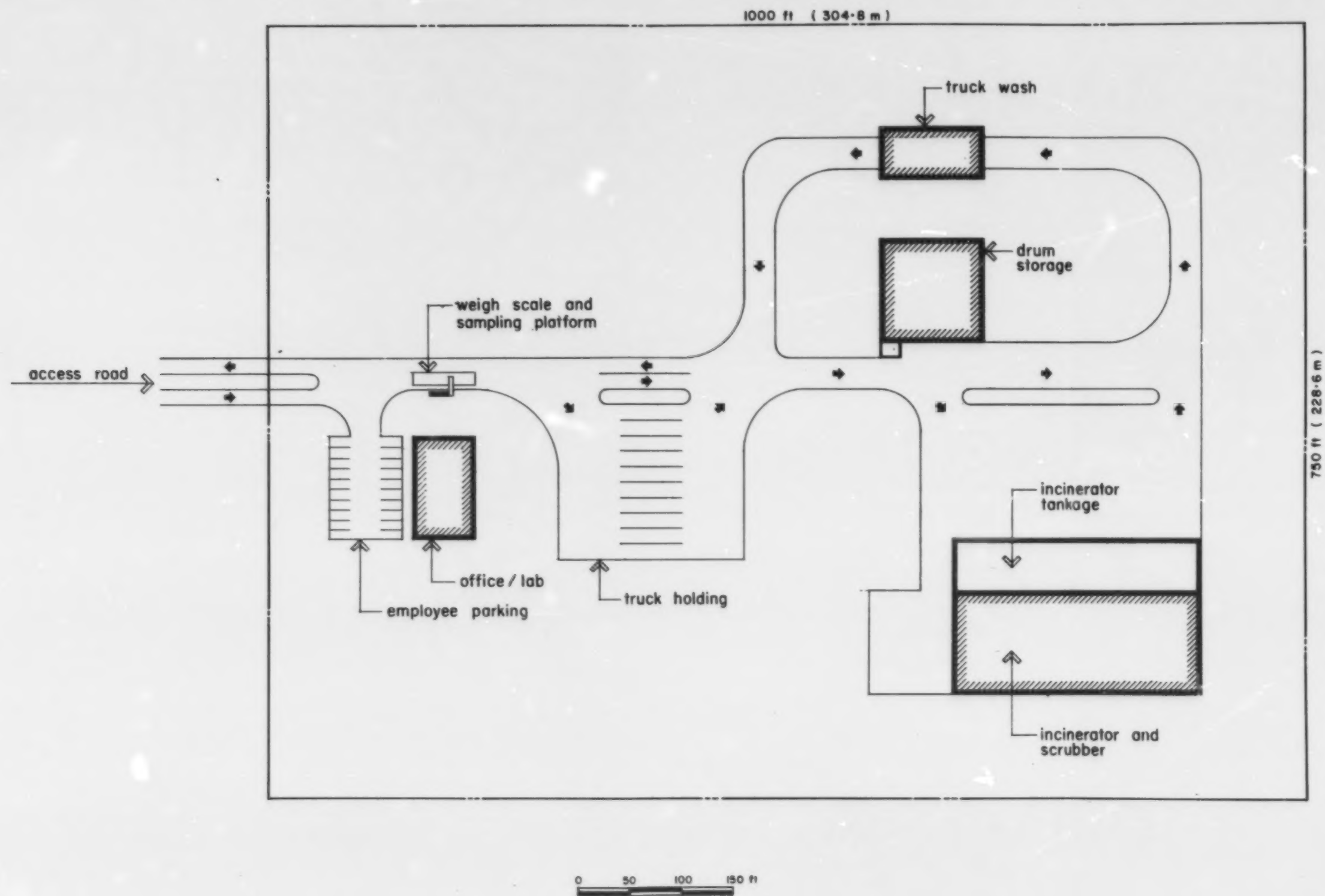
SITE LAYOUT
PHYSICAL - CHEMICAL
TREATMENT ONLY

figure
6a



SITE LAYOUT
INCINERATION AND
PHYSICAL - CHEMICAL
TREATMENT

figure
6b



Depending upon the solidification process, the solidified residues when delivered to the landfill may have the appearance of lean concrete or a granular earth-like material. After placing and compacting (if necessary), the solidified material will form a monolithic mass of very low permeability.

The solidified residues will be odourless and safe to handle. The solidification process will chemically bind the treated residue into the solidified material, which will have an extremely high resistance to the redissolution of residue constituents. The very low permeability of the in-place solidified product and surface drainage control to minimize the entry of water into the landfill will result in a very low rate of leachate production.

LANDFILL AS ULTIMATE DISPOSAL

The objective of the engineered landfill is to contain the treated solidified material indefinitely without threat to human health or the environment. The principal concerns are the avoidance of ground and surface water contamination. In this regard, the following measures will be applied:

- Providing for engineered features and operational techniques that provide ground water and surface water protection.
- Locating the landfill in an area that naturally restricts contaminant movement. This provides additional natural protection of ground water and surface water.

- Monitoring the landfill design and operations to ensure that ground and surface water resources are protected as predicted.
- Providing for contingency measures to be implemented in the event that monitoring shows the landfill design is not functioning as predicted.

LANDFILL CHARACTERISTICS AND POTENTIAL IMPACTS

The landfill operation will be such that the minimum area is open for active landfilling at a given time. This active cell is envisaged as being no larger than the volume required to accommodate one year's volume of solidified material. This cell will be excavated and any engineered features will be installed prior to placing the solidified product.

The solidified material will be odourless and safe to handle. It will set or be compacted into a monolithic mass. The material is not attractive to birds or other animals for feeding, and will not encourage rodents. The minimum time for the exposure of excavated clay faces also should not encourage birds. Little or no dust is expected from the in-place solidified product. Excavation or cover operations in a dry period inevitably will produce some dust.

The solidified material is produced from inorganic waste residues, inorganic reagents such as cement and inorganic residues such as fly-ash. Gas generation is not anticipated. Similarly leachate production is anticipated as being minimal in quantity and good in quality. These factors distinguish this engineered landfilling of solidified inorganic material from traditional municipal landfilling of garbage which is mainly organic and which degrades to form methane gas and organic contaminated leachates.

In summary, the potential impacts from the engineered landfill on nearby land users relate to noise from trucks and excavating equipment, together with the possibility of dust at some periods, and appearance of the landfill. The latter can be minimized by landscaping. Dust control can be employed on access roads on and adjacent to the site. Noise impacts can be limited to the daylight hours and minimized by a separation distance from nearby sensitive receptors. These factors were considered in the definition of the study area for the potential sites.

CHAPTER 4 TECHNICAL BUFFERS

INTRODUCTION

The technical buffer can be viewed as a level of protection beyond that provided by the best proven technology and the best operating procedures that can be implemented by the OWMC within the operations area.

The technical buffer will be an area of land, owned by or otherwise under the control of OWMC as an integral part of the site, immediately surrounding the operations area. As a minimum the operations area will be fenced. Fencing of the complete site including the technical buffer will also be considered.

Under normal operations, the conditions within the operations area must necessarily be safe and pose no risk to the health of the workers. Thus, as discussed in Chapter 3, with normal operations the technical buffer serves to minimize nuisance effects on land users abutting the site.

The provision of a technical buffer recognizes that it is impossible to be absolutely certain that unforeseen events will not occur despite all precautions. Such events could result in short-term abnormal or emergency conditions and the technical buffer must provide protection against the effects of such conditions.

As a further level of protection aimed at minimizing the risk of nuisance impacts, the site selection process has compared land uses and environmental sensitivity within 1 km of the cores of the

operations areas for the incinerator and physical/chemical treatment plant and 500 m from the landfill site. Also within 5 km of the incinerator and physical/chemical treatment plant, a comparison was made by other site selection consultants of population distribution, ambient air quality and land use patterns.

This Chapter includes the technical rationale for the technical buffer.

TECHNICAL BUFFER FOR LANDFILL

The technical buffer for the landfill is based on work by Gartner Lee Associates Limited.³

The engineered landfill will be sited in an area of thick clay. Weathering of clays is typically in the top 3 m to 5 m and results in a network of fine fractures. Lateral flow of water through the fractures in this weathered zone can be at a rate of a few metres per year. In the deeper unweathered clay, molecular diffusion controls contaminant movement and the rate of movement is typically in the range of a few centimetres per year.

Because ground water movement to depth is slow in relation to shallow lateral movement, any contaminants introduced into the ground water flow system have the potential to move considerably faster laterally through the fractures than vertically through the unweathered clay. There is uncertainty associated with whether this potential rate of movement will ever occur in the fractures. This is primarily due to the diffusion of the contaminants from the fractures into the adjacent soil matrix, resulting in much slower movement than theoretical calculations suggest. Gartner Lee concluded that ground water monitoring and contingency

remedial measures therefore must be designed to accommodate shallow lateral movement through fractures in the event that it occurs. The distance adjacent to the landfill area for monitoring and remedial measures, could be based on some measurable time interval that permits detection of movement and installation of contingency systems. Gartner Lee also noted that this distance could be minimized by engineering the shallow subsurface clay to enhance contaminant containment. This could involve technologies such as excavating to the base of the weathered clay and restructuring these materials using local or imported soil material of lower hydraulic conductivity to eliminate near surface fractures.

A synthetic membrane liner can also be used in conjunction with the clay to achieve a double protection against leachate migration.

With the landfilling of a solidified material resistant to leaching, and the use of drainage control, monitoring and a contingency collection system, the risk of contaminant migration off-site is low. The slow rate of lateral movement in the adjacent clay suggests that 50 m is an adequate distance from the edge of the landfilled area to contain the contaminant monitoring and contingency collection systems and allow sufficient lead time to undertake any required remedial action. This distance should be re-assessed on a site-specific basis during final design.

In view of these provisions the emissions of concern from the landfill area therefore will be dust from earth moving operations and transport of solidified waste, and the associated equipment or traffic noise. These will be at approximately the same level as those from a municipal landfill, and the MOE guideline of 500 m as a study area was adopted as a reasonable value. The MOE guidelines are further discussed in Chapter 5 of this report.

TECHNICAL BUFFER FOR INCINERATOR AND PHYSICAL/CHEMICAL TREATMENT PLANT

APPROACH

The approach to defining the technical buffer for the incinerator and the physical/chemical treatment plant was to assess emissions occurring under extremely abnormal operating conditions and to ensure that the emissions under such conditions would be at a safe level at the boundary of the technical buffer. Consequently, this approach required two major activities:

- Definition of abnormal operating conditions producing emissions;
- Definition of criteria for safe conditions at the boundary of the technical buffer.

The abnormal operating conditions were defined by assuming that events occurred which produced noxious and/or toxic emissions. An analysis of potentially dangerous situations was based on the waste inventory data provided by OWMC.

Safe conditions at the boundary of the technical buffer were defined in two ways: using the permissible maximum half hour concentrations set out in Schedule 1 of Ontario Regulation 308 "Air Pollution Control (General) Regulations"; and by using allowable eight hour exposures defined by the American Conference of Governmental Industrial Hygienists.¹ As discussed in a following section, both of these criteria for safe conditions can be viewed as safely conservative in relation to ensuring that health is not threatened by extremely infrequent, short-duration emission events.

Thus, it is emphasized that the approach to defining the technical buffer is safely conservative in relation to ensuring that human health is not threatened. This conservatism is consistent with using the technical buffer also to minimize nuisance effects under normal operating conditions on the environment adjacent to the site and outside the actual area owned by OWMC.

It is emphasized that the hypothetical emission events would result from abnormal operating conditions not at all representative of the normal operating conditions generally expected at the facilities.

ABNORMAL OPERATING CONDITIONS

The approach to defining emergency conditions was to hypothesize events leading to noxious or toxic emissions of gases. The actual causes of the hypothetical events have not been considered in any detail. The causes can be considered as highly unlikely combinations of circumstances such as operator error in conjunction with the failure of both equipment and back-up systems. This approach defines a worst case. Implicit in it is the realization that, despite the best design, operating controls and operating procedures, such conditions may occur and must be allowed for.

The probability or risk of the worst case events happening has not been calculated. It is reasonable to state that the probability or risk of such an event occurring is extremely small.

The risk analysis undertaken to date is qualitative rather than quantitative. It recognizes the relative hazard in handling and treating the wastes as characterized at present. Events were selected by reviewing the wastes to be stored, treated or destroyed in relation to present thinking relative to storage,

treatment and destruction methods, and identifying potentially hazardous combinations of wastes and/or treatment chemicals, equipment failures and potential operator error.

The events selected and analyzed in arriving at the worse case scenarios are listed in Table 2.

RATIONALE FOR EMISSION CASES

The cases considered all involve the generation and emission of noxious or toxic gases and are referred to as emission scenarios. The selection of these scenarios was based on the possible effects of the emitted substance on humans or the environment, and on the possibility of the substance being accidentally generated and emitted in a significant quantity. In effect, engineering judgment was used to arrive at the list of emission scenarios. For example, if a waste was expected to be received in extremely small quantities, it would be unrealistic to expect that it could accidentally lead to emissions of sufficient quantity to govern the sizing of the technical buffer. Similarly, it was considered to be unrealistic to consider the emission of a highly toxic substance if no realistic mechanism could be hypothesized for its accidental generation and emission in significant quantities.

The emission scenarios selected for analysis include two for the physical/chemical treatment plant (Cases 1 and 2) and four (Cases 3, 4, 5 and 6) for the incinerator. This reflects the fact that the incinerator destroys organic wastes, some of which are very volatile and highly combustible. Also as noted in Chapter 3, the combustion processes in the incinerator may produce toxic gases, such as hydrogen chloride, which are removed by the scrubber as part of the normal operation. Thus abnormal operation of the scrubber must be considered. The inorganic wastes handled

TABLE 2
HYPOTHETICAL EMISSION SCENARIOS
TECHNICAL BUFFER ZONE DEVELOPMENT

Case 1	Physical/Chemical Treatment Plant Operating error	Accidental mixing of strong acid with waste containing cyanide resulting in hydrogen cyanide gas (HCN).
Case 2	Physical/Chemical Treatment Plant Operating error	Accidental mixing of strong acid with waste sulphides in liquid or solid form resulting in hydrogen sulphide gas (H ₂ S).
Case 3	Incinerator Storage of halogenated hydrocarbons prior to incineration	External fire causing vaporization of 1,1,1-trichloroethane (CH ₃ CCl ₃) and emission of vapour via tank vent above the maximum flame level.
Case 4	Incinerator Incinerator flue gas scrubber - reduction in efficiency	Reduction in scrubber efficiency to 80% with increased emissions of sulphur dioxide (SO ₂).
Case 5	Incinerator Incinerator flue gas scrubber total failure	Sudden failure of scrubber leading to short-term increase in emission of pollutants. Sulphur dioxide (SO ₂) from the incineration of sulphur sludges, and hydrogen chloride (HCL) from the incineration of halogenated hydrocarbons were considered as representative emissions.
Case 6	Incinerator Storage of aromatic hydrocarbons prior to incineration	Toluene emissions considered for three cases: fire; breathing of tank via vent system; major spill due to rupture of storage tank.

by the physical/chemical plant are generally of low volatility and combustibility, thus reducing the risk of gaseous emissions and restricting the scenarios to the accidental mixing of chemicals.

RATIONALE FOR SAFE CONCENTRATION CRITERIA FOR GASEOUS EMISSIONS

GENERAL

The emission scenarios identified for consideration all produce gaseous emissions which will disperse from the source. For example, the generation of hydrogen sulphide from the accidental addition of a strong acid to sulphide wastes would result in an emission of this gas via the ventilating system of the physical/chemical treatment plant. The gas would be at its highest concentration close to the source of its generation and be diluted by the air in the building, and then further diluted as it left the building and dispersed into the atmosphere.

For the six emission scenarios, the concentration of a pollutant in the atmosphere at different distances from a source could be calculated using the rate of emission at the source and the assumed atmospheric conditions. With the calculated concentrations at various distances from the source, a criterion was needed to determine if the concentration was permissible at a given distance. The purpose of the technical buffer is to avoid risk to human health and to minimize nuisance effects and impacts to the environment, especially from potential accidental emissions.

The Province's air emission standards were adopted to define the maximum permissible concentration of a pollutant. This represents a very safe approach in relation to avoiding human

health risks for short duration emissions. This is illustrated in the following Table 3 which compares the Province's allowable half-hour average concentrations with the threshold limit values (TLV) defined by the American Conference of Governmental Industrial Hygienists (ACGIH). The Province's allowable half-hour concentrations are much lower than the TLVs defined by ACGIH. This is to be expected when comparing an air quality standard for air pollution control with an occupational health standard.

THRESHOLD LIMIT VALUES

Threshold limit values (TLVs) for the exposure of employees to particular pollutants have been established by ACGIH¹. The basic concept of TLVs is that they refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. TLVs are widely accepted in North America as the basis for protecting the health of employees exposed to pollutants in the workplace. "Control of the work environment is based on the assumption that for each substance, there exists some safe or tolerable level of exposure below which no significantly adverse effect occurs. These tolerable levels are referred to as threshold limit values".¹¹

Table 3 includes three categories of TLVs. The time weighted average (TWA) value is generally defined as the time weighted average concentration for a normal eight hour work day and 40 hour work week, to which nearly all workers may be repeatedly exposed, day-after-day, without adverse effect.

Table 3 also includes published values for the threshold limit value - short-term exposure limit (TLV-STEL). This is defined as the maximum concentration to which workers can be

exposed for a period of up to 15 minutes continuously, provided that no more than four exposures per day are permitted with at least 60 minutes between exposure periods.

For some substances, such as irritant gases, TLV-TWA and TLV-STEL are replaced by a single value - the threshold limit value-ceiling (TLV-C). This is the concentration that should not be exceeded even instantaneously if a health hazard is to be avoided. These values are also included on Table 3.

TLVs are based on repeated exposures to a substance and are not directly applicable to defining allowable conditions in emergencies such as short duration accidents occurring extremely infrequently, but TLVs do provide a yardstick for assessing probable effects of the concentrations resulting from an accidental emission. As an example, if a short duration concentration is less than the TLV-TWA it can be judged not to pose a known hazard to human health.

The National Institute for Occupational Health and Safety (NIOSH) of the U.S. Department of Health, Education and Welfare and the Occupational Safety and Health Administration (OSHA) have published "Immediately Dangerous to Life or Health" (IDLH) concentrations for various substances. The IDLH concentration represents a maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects. The levels are included in Table 3 for comparison purposes.

EMISSION STANDARDS IN ONTARIO

In Ontario, criteria and standards for the control of air pollution are published in regulations under the Environmental Protection Act. The source emission standards are called point of

impingement standards and are stated in Schedule 1 of Ontario Reg. 308 as half hour average concentrations in micrograms of the contaminant per cubic metre of air. Ambient air quality criteria are set out in the Schedule of Ontario Reg. 296.

The rationale used in Ontario for determining ambient air quality objectives and emissions standards has been described in detail in a paper by staff of the Ministry of the Environment⁶ from which the following has been summarized.

In Ontario, air pollution control is based solely on the philosophy of effects. For a particular contaminant, a level is defined which will protect the environment (man, animals, vegetation and property) from any significant known adverse effect. This level is stated in-terms of concentration and time and is referred to as the ambient air quality objective or the desirable ambient air quality criterion. Normally, this is stated as a 24-hour average concentration, but it may be, and often is, supported by concentrations over other time periods, such as the average annual or average hourly concentrations. Once the ambient air quality objective has been established, a man-made emission of the contaminant can be controlled by an emission standard designed such that through its use, the ambient air quality objective will be attained.

Emission standards in Ontario recognize that ambient air quality is a function of both the emission and the transport and dispersion of the emission in the air. The emission standards in Ontario are not stated as concentrations over a time period at the source of the emission. Rather they are stated as a concentration over a time period at the point of impingement of the effluent stream on a receptor. All Ontario emission standards are stated as point of impingement standards in terms of half-hour average

TABLE 3
CURRENT EXPOSURE LEVELS MOE - SOURCES: REGULATION 308,
ENVIRONMENTAL PROTECTION ACT, TLVs - 1983-84
ACGIH, IDLHs - 1979 NIOSH/OSHA (current)

	Allowable Half-hour (MOE) ug/m ³	TLV-TWA (ACGIH) ug/m ³	TLV-STEL (ACGIH) ug/m ³	TLV-C (ACGIH) ug/m ³	IDLH (NIOSH/OSHA) ug/m ³
Antimony & compounds as Sb	75	500	-	-	80,000
Arsenic + sol. compounds as As	75*	200*	-	-	21,000(AsH ₃)
Benzene	1,000	30,000	75,000	-	7,000,000
Beryllium	0.03	2	-	-	-
Boron B ₂ O ₃	100	1,000	-	-	-
(total)					
B ₂ O ₃		1,000	20,000	-	N/A
Cadmium CdO, fume as Cd	5.0	-	-	50	40,000
dust and salts as Cd	(total)	50	200	-	40,000
Calcium oxide	20	2,000	-	-	250,000
Carbon tetrachloride	20,000	30,000	125,000	-	1,900,000
Chlorine	300	3,000	9,000	-	74,000
Chromium metal, II, III, as Cr	30	500	-	-	250,000-500,000
Cr (VI)	(total)	50	-	-	30,000
Dust (general, ug/m ³)	8,000	-	-	-	-
Fluorides (as HF) as F	4.3-17.2	2,500	5,000	-	17,000
Hydrogen chloride	100	-	-	7,000	150,000
Hydrogen cyanide, skin	1,150	-	-	10,000	56,000
Hydrogen sulfide	30	14,000	21,000	-	420,000
Iron Sol. salts as Fe	10	1,000	2,000	-	-
Fe ₂ O ₃ fume as Fe	(total)	5,000	10,000	-	N/A
Lead, inorganic dusts/fumes as Pb	10	150	450	-	Variable
Lithium as LiH	7.5	25	-	-	50,000
Other than LiH	60	-	-	-	-
Manganese Dust and compounds as Mn	100	-	-	5,000	20,000,000
Fume as Mn	(total)	1,000	3,000	-	
Mercury alkyls	1.5	10	30	-	25,000
vapour as Hg		50	-	-	(vapour)
other	5.0	100	-	-	
metal		1	-	-	
Nickel sol. compounds as Ni	5.0	100	300	-	-
Nitric Acid	5.0	5,000	10,000	-	250,000
Nitrogen Oxides NO	500	30,000	45,000	-	110,000
NO ₂	(total)	6,000	10,000	-	96,000
Sulphur dioxide	850	5,000	10,000	-	270,000
Toluene	2,000	375,000	560,000	-	7,600,000
1,1,1-trichloroethane	350,000	1,900,000	2,450,000	-	5,600,000
Vanadium resp. dust + fume	5.0	50	-	-	70,000
as V ₂ O ₅					
Xylene	2,300	435,000	655,000	-	44,000,000
Zinc ZnCl ₂ fume	100	1,000	2,000	-	-
ZnO fume	(total)	5,000	10,000	-	11,300,000
PCB 425/545	0.45	1/0.5	2/1	-	0.1**

Note: * Currently under review in Ontario as a "designated substance" by Ministry of Labour.

** Proposed 1982

concentrations. The following main factors are considered in determining any half-hour impingement concentration standard aimed at attaining the ambient air quality objective:

- Relationship between air contaminant concentrations and sampling time, which recognizes that the highest measurements of a contaminant will occur over short periods of time. Consequently, the average concentration at a given sampling site will be lower, the longer the averaging time chosen. This is used to translate ambient air objective in terms of a 24-hour average concentration to a half-hour average concentration.
- Background contaminant concentration. This is usually done by considering whether the contaminant is a commonly emitted one or whether it is an unusual one, or if it is present in the natural environment in significant concentration. Number of sources and transport are also considered.
- Unique factors such as synergistic effects, air reactions and special health considerations.
- Practical considerations of emission control related to such items as substances which have a wide range of concentration for the reported odour threshold, and the effectiveness of current control technology.

In summary, the emission standards (half-hour point of impingement concentrations) are set to ensure that the ambient air quality objectives (normally 24-hour average concentrations) are achieved thus ensuring that there are no significant known adverse effects on the environment.

The Province's emission standards are appropriate in relation to the normal operation of OWMC's facilities, such as continuous emissions from the incinerator stack. By using the best practicable technology OWMC can reduce emissions to a point which will produce ground level concentrations well within the emission standards.

In relation to an isolated short-duration accidental emission, the Province's emission standards are considered to be conservative. Over a long time period, a short-term emission concentration may have only a small effect on the average concentration used as the ambient air quality objective. Short-term upset emissions are not normally judged by the Ministry of the Environment against half-hour point of impingement standards. Nevertheless, in defining the technical buffer in a rural or light industrial site setting it was considered appropriate to use the Province's emission standards in terms of point of impingement half-hour concentrations. This is consistent with minimizing effects and nuisance to land users abutting the technical buffer.

In a heavy industrial setting, the adjacent land uses would be more compatible with OWMC's physical/chemical treatment plant and incinerator. Emission from normal operations would be governed by the Province's emission standards and might require particular consideration of existing local background concentration levels. For short-term accidental emissions, the Province's half-hour point of impingement concentrations could be considered as being overly conservative. Thus in a heavy industrial setting an alternative approach to defining the technical buffer was used based on containing a concentration equal to one half of the TLV-TWA within the technical buffer. This approach ensures that under the accidental emission scenarios there was no known risk to the health of workers at adjoining industries.

EMISSIONS RESULTING FROM ACCIDENT SCENARIOS

GENERAL

The calculations used to determine emissions and point of impingement concentrations follow the method detailed in the appendix of Regulation 308. The results of these calculations are summarized in the following sections. Multiple stack heights were used in the calculations. These are consistent with the range of values used by ORF³ in their preliminary work. When the worst case was determined, the corresponding value of stack height was adopted without recalculation of the previous cases. To do so would only have reduced the ground level concentrations calculated for those cases.

CASE 1, EMISSION OF HYDROGEN CYANIDE GAS (HCN)

Accidental mixing of strong acid with solutions containing cyanide will generate this toxic hydrogen cyanide gas. Simple cyanides, which are not metal complexed, will react fairly quickly with consequent high gas generation rates. Cyanides, when complexed with metals will react more slowly and only with a large excess of acid.

Engineering and operational safeguards will prevent the gross contamination of waste cyanides with acid. It is considered that if such safeguards fail, the worst probable occurrence would be the accidental addition of a barrel of acid to cyanide waste or vice versa. In relation to defining the technical buffer, based on the emission of this gas, it was concluded that the results of such an accident would not be significant for the following reasons:

- Cyanides in wastes frequently are highly complexed with heavy metals. Thus, even large amounts of excess acid produce only slow reaction rates with low generation rates for the HCN gas.
- The actual rate of gaseous emission of HCN from such a solution is low. (Industrial operations often require air stripping to remove this gas because of its high solubility in water.)

Thus the generation and emission of this gas within the physical/chemical treatment plant probably would be at slow rates and of insufficient quantity to have significant influence in defining the technical buffer. Therefore, the accidental emission of hydrogen cyanide from the physical/chemical treatment plant was not considered to be a decisive factor in defining the technical buffer.

CASE 2, EMISSION OF HYDROGEN SULPHIDE GAS (H_2S)

Accidental mixing of a strong acid with either a liquid or a solid containing sulphides will generate this toxic and malodorous hydrogen sulphide gas.

As noted for the accident case involving cyanide, it was assumed that operational and engineering controls would prevent the gross contamination of sulphide wastes with strong acid, and that the worst probable occurrence would be the accidental addition of a barrel of strong acid to sulphide wastes or vice versa.

Unlike the cyanide case, the reaction for hydrogen sulphide generation requires little excess acid and may proceed at a rapid rate, particularly if the sulphide compound is readily soluble in water.

The accident case analysed assumed that one 55 imperial gallon barrel (250 L) of 4% sulphuric acid was mixed with sulphide contaminated material in the physical/chemical treatment building. The gas is emitted first into the building and then via its ventilation system to the atmosphere at roof level at 10.7 m (35 ft.) aboveground.

Hydrogen sulphide gas is slightly more dense than air and has a tendency to collect in low-lying areas. Thus the acute problems associated with the accidental release of this gas will be found in the immediate area of the emission, close to the physical/chemical treatment building rather than within or at the limit of the technical buffer.

The emission standard for hydrogen sulphide in accordance with Regulation 308 is a half-hour average point of impingement concentration of 30 ug/m^3 . As shown on Figure 7, this limiting concentration occurs at a distance of 160 m to 360 m from the source of emission depending upon the atmospheric conditions. The longer distance of 360 m was considered appropriate in defining the technical buffer.

At a distance of 400 m from the emission source the half-hour average concentration is between 9.6 and 26.5 ug/m^3 depending upon the atmospheric conditions. The concentration of 26.5 ug/m^3 is extremely small in relation to occupational health and safety standards such as the TLV-TWA of $14\ 000 \text{ ug/m}^3$.

As shown on Figure 1 in Chapter 2 of this report, the operations area of the physical/chemical treatment plant and incinerator may extend from about 100 to 125 m from the probable emission source. At a distance of a 100 m from the emission source, the calculated half-hour average concentrations of hydrogen

PLOT OF H₂S CONCENTRATION VS DISTANCE

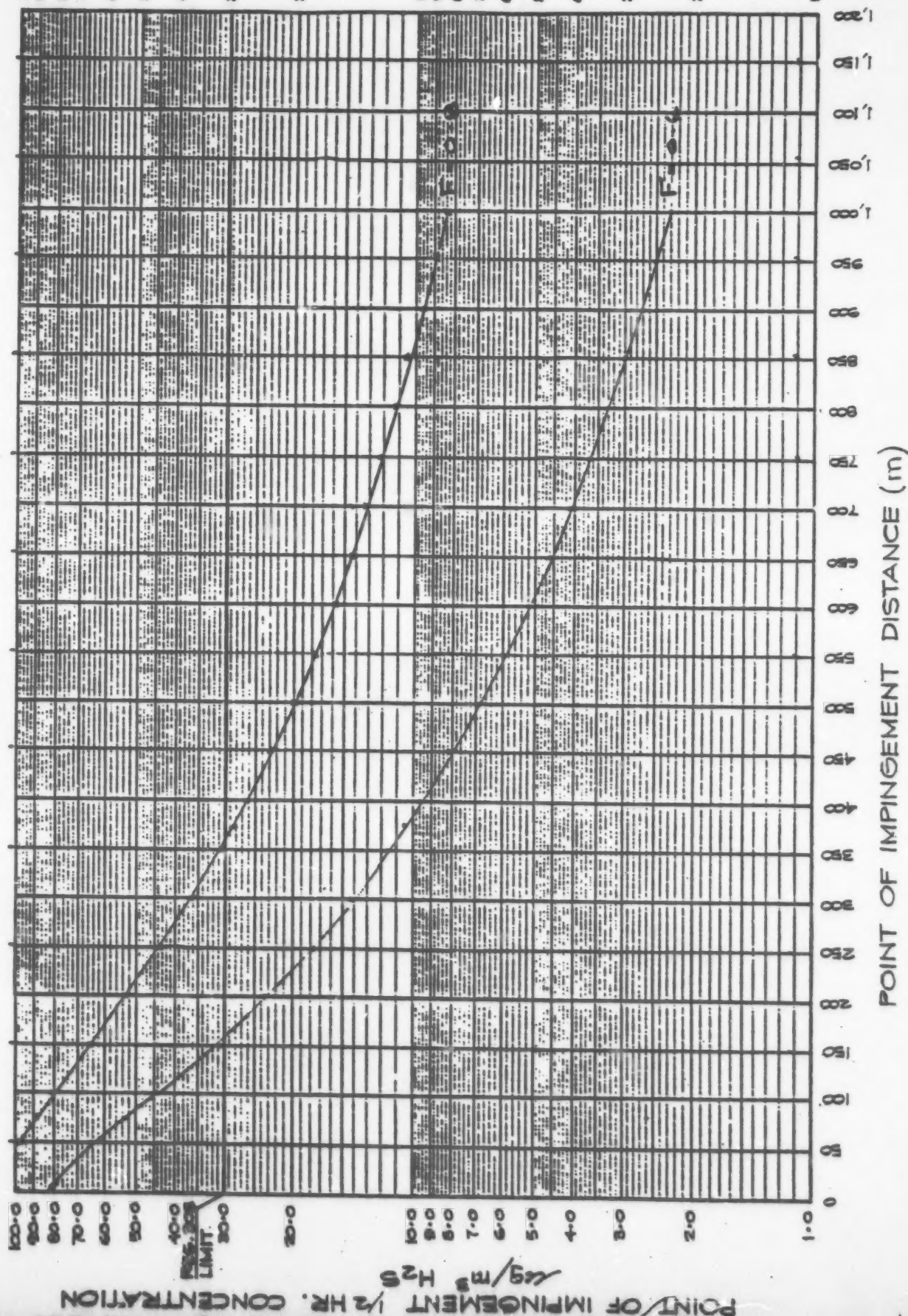


FIGURE-7

sulphide are between 44 and 80 ug/m³ depending upon atmospheric conditions. These levels are extremely low in relation to the TLV-TWA of 14 000 ug/m³. Thus the accident case involving hydrogen sulphide results in short-term emissions with concentrations at the limit of the operations area less than 0.6 of one per cent of that level to which workers may be repeatedly exposed, day after day, without adverse effect. This suggests that in a heavy industrial setting, no buffer beyond the operations area would be required based on this accidental emission involving hydrogen sulphide.

Under the extremely abnormal operating conditions as analyzed for Case 2, there will be no known risk to life or health at the boundary of the operations area 100 m from the source of emission or within a technical buffer defined as 360 m from the source of emission based on air pollution emission standards. By virtue of the rationale for determining emission standards in Ontario, compliance with the Province's air emission standards at the buffer limit indicates that there will be no known significant impact on the environment outside the buffer. For the short time period during an accidental emission, there is some risk of a nuisance odour of hydrogen sulphide at distances in excess of 1 km for a very sensitive nose.

Under normal operating conditions odour from hydrogen sulphide should not be a problem. Inorganic sulphide wastes, whether in liquid or solid form, are generally stable. Organic wastes such as hydrocarbon solutions containing hydrogen sulphide may produce odours by evaporation of hydrogen sulphide. However, such sour hydrocarbon wastes are not expected to be handled in significant quantity by the incinerator. Essentially, all of these sour hydrocarbon wastes are disposed of at the refineries where they originate.

Based on the analysis of Case 2, involving the accidental emission of hydrogen sulphide, it was concluded that the technical buffer for the physical/chemical treatment plant in a rural setting should be 400 m to minimize the risk of nuisance under normal or abnormal operating conditions. In an industrial setting, it was concluded that a technical buffer may not be required and that the operations area would be adequate to ensure no significant impacts occurred to the adjacent land uses.

CASE 3, EMISSION OF 1,1,1-TRICHLOROETHANE (CH_3CCl_3)

Various halogenated hydrocarbons will be incinerated at the Corporation's facilities. No detailed breakdown of the types of these wastes is available at present from the UCD waste classifications. A reasonable assumption is that 1,1,1-trichloroethane will be present in substantial quantities because of its widespread use as a degreasing agent and dry cleaning solvent. Other compounds such as carbon tetrachloride may also be present but in smaller amounts.

Volatility and flammability of halogenated hydrocarbons vary widely. It was assumed that highly volatile and/or highly flammable materials such as chloroform would not be stored in large quantities.

The main solvents of concern have boiling points in excess of 100°C . Trichloroethane is flammable over the range of 6% to 15% by volume in air. Trichloroethane was considered to be representative of solvents which will be stored and incinerated in significant amounts.

The following key assumptions were made relative to the storage of trichloroethane:

- The maximum capacity of a storage tank would be limited to 2,500 US gallons (9 465 L). A larger tank would increase the calculated emission rates.
- The storage tank would not be insulated or fireproofed. Insulation or fireproofing would reduce the calculated emission rates.
- All tanks storing halogenated hydrocarbons would be vented via a common 10 in. (254 mm) stack with a minimum tip height of 30 ft. (9.15 m). This height places the point of vapour emission above the level of flame effect in the event of a fire surrounding the tank. This will avoid the vapour being in contact with the flames which could result in partial combustion of trichloroethane producing phosgene and hydrogen chloride. The use of a vent system will permit the use of a central vent point remote from the actual storage tanks.
- Storage area design will ensure that only one tank will be surrounded by fire.

Based on these assumptions, Case 3 involves the emission of 1,1,1-trichloroethane as a vapour caused by an external fire boiling the contents of an initially full storage tank. The emission calculations followed the method detailed in the Appendix of Regulation 308. The calculated half-hour average concentrations at an impingement height of 1.5 m at various distances from the source of the emission are shown on Figure 8.

The Provincial emission standard for trichloroethane as a half-hour average point of impingement concentration is 350 000 ug/m³. Figure 8 shows this to occur at a distance of

PLOT OF CH_3Cl_3 CONCENTRATION VS. DISTANCE

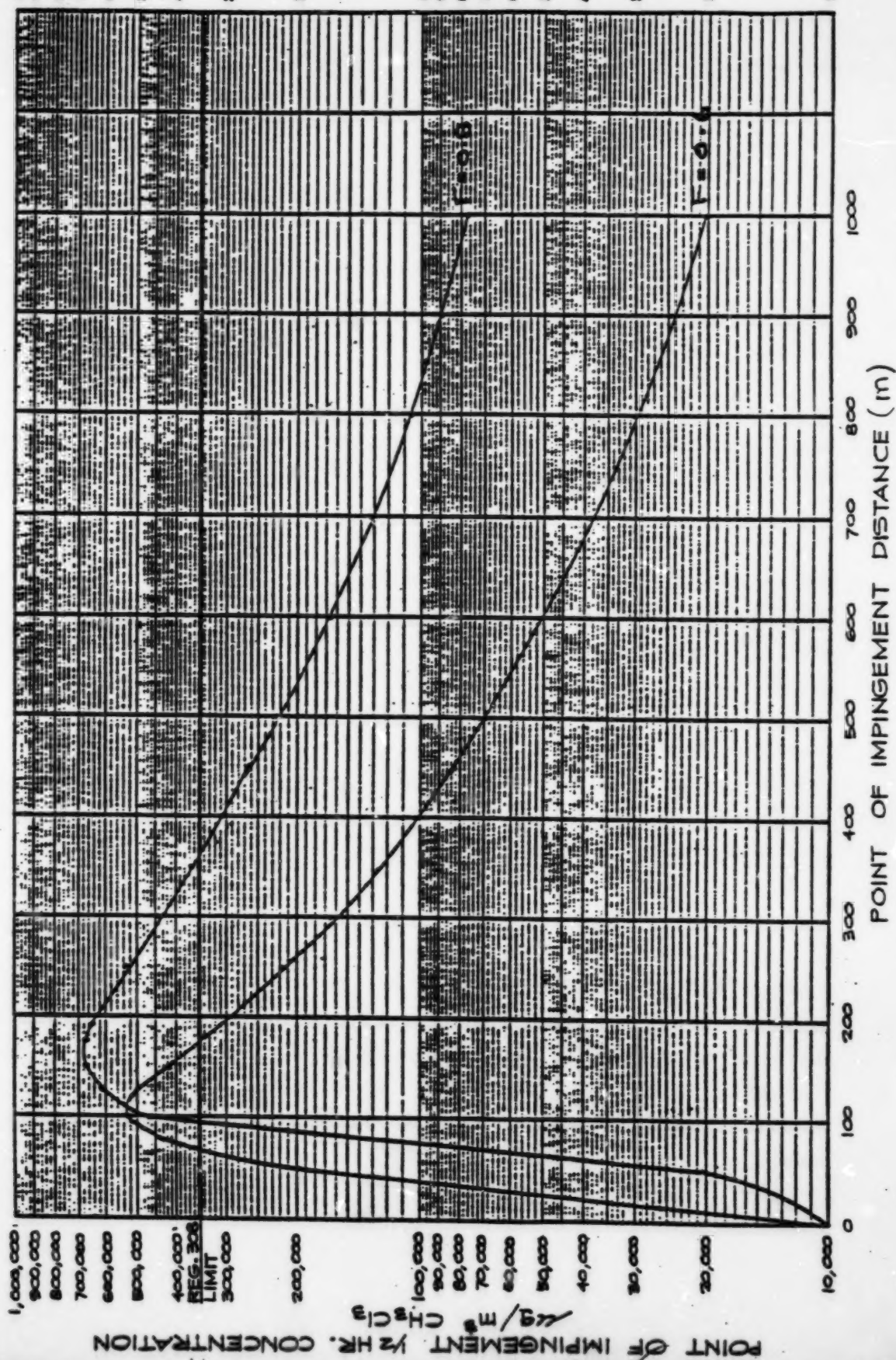


FIGURE - 8

175 m to 350 m from the emission source depending upon atmospheric conditions. The longer distance was considered appropriate for technical buffer considerations.

At a distance of 400 m from the source, the calculated half-hour average concentration is between 103 000 and 309 000 ug/m^3 depending upon the atmospheric conditions. The higher value of 309 000 ug/m^3 is small in relation to occupational health and safety standards such as the TLV-TWA of 1 900 000 ug/m^3 .

At a distance of 100 m from the emission source the calculated half-hour average concentrations are between 461 000 and 528 000 ug/m^3 compared to the TLV-TWA of 1 900 000 ug/m^3 .

The maximum calculated point of impingement half-hour average concentration is about 680 000 ug/m^3 and occurs at about 170 m from the source. This maximum is about 36% of the TLV-TWA. Thus the accident case involving 1,1,1-trichloroethane results in short-term emissions with maximum half-hour average concentrations well below one half of that level to which workers may be repeatedly exposed, day after day, without adverse effect. This suggests that in a heavy industrial setting no buffer beyond the operations area would be required based on this accidental emission involving 1,1,1-trichloroethane.

Under the abnormal operating conditions as analysed for Case 3 there will be no known risk to life or health at the boundary of the operations area at 100 m from the source of emission or within a technical buffer defined as 360 m from the source. By virtue of the rationale for defining emission standards in Ontario, compliance with these standards at the technical buffer limit indicates that there will be no significant impact on the environment outside the buffer. Because of the

odour threshold for trichloroethane ($2.1-3.9 \times 10^6 \text{ ug/m}^3$), no nuisance odour will occur for abnormal or normal operating conditions.

Based on the analysis of Case 3, involving the accidental emission of 1,1,1-trichloroethane as a representative halogenated hydrocarbon, it was concluded that the technical buffer for the incinerator in a rural setting should be 400 m to minimize the risk of nuisance under normal and abnormal operating conditions. In a heavy industrial setting, it was concluded that a technical buffer may not be required.

CASE 4, INCINERATOR FLUE GAS SCRUBBER-REDUCTION IN SULPHUR DIOXIDE (SO₂) SCRUBBING EFFICIENCY

This case is peculiar to the incinerator's flue gas emission control train. The postulated case involves a long-term reduction in scrubber efficiency to the 80% level with SO₂ and other emissions increasing accordingly. Continued operations under such conditions is difficult to imagine but the calculated maximum ground level point of impingement SO₂ concentration, as a half-hour average, is less than 400 ug/m³ at a distance of about 1 000 m from the source, assuming a 50 m stack height. This concentration is less than half of the Ontario emission standard of 830 ug/m³ as a half-hour average concentration and thus the case is not critical in determining the technical buffer.

CASE 5, INCINERATOR FLUE GAS SCRUBBER - TOTAL FAILURE

This case postulates a sudden total failure of the flue gas scrubber resulting in a substantial increase in pollutant emission. Increases in stack gas temperature and stack exit velocity would also occur.

The key assumption applied in this emergency situation is that such a failure by virtue of the operations monitoring would be immediately obvious and that all waste feed would be shut-off within 3 min. after the failure and that emission rates from the stack would then decrease exponentially with time.

Peak rates of incineration have been assumed to be occurring at the time the scrubber fails. Two pollutants have been considered:

- Sulphur dioxide (SO_2) resulting from the incineration of sulphur sludges.
- Hydrogen chloride (HCl) resulting from the incineration of halogenated hydrocarbons.

Sulphur Dioxide (SO_2) Emissions

Assuming a 75 m stack height, the calculated maximum level point of impingement concentration is 520 to 530 $\mu\text{g}/\text{m}^3$ at a distance of approximately 1700 m. This maximum concentration is well below the limit of 830 $\mu\text{g}/\text{m}^3$ given in Regulation 308 and thus was not considered to be a factor in setting the technical buffer.

The waste inventory information used to develop the emission rate appears to be highly conservative in the light of subsequent data. Given the reduction in sulphur levels in the waste, shorter stacks would meet the criteria adopted in this report for buffer zone determination.

Hydrogen Chloride (HCl) Emissions

Total failure of the scrubber was assumed to occur when the emission rate of hydrogen chloride was equivalent to twice the steady rate anticipated on an annual basis.

For the total scrubber failure, maximum half-hour ground level concentrations of 166 and 79 ug/m^3 were calculated for 50 m and 100 m stack heights respectively at distances of approximately 1200 m and 2000 m from the point of emission.

The limit given in Regulation 308 is a half-hour average concentration of 100 ug/m^3 , and the maximum concentration from a 100 m stack is well within this limit. If shorter stack heights are considered, then mitigative measures would also have to be considered in order to limit the actual hydrogen chloride emission levels. These could be either operational or engineering in nature.

On the basis of these assumptions, the calculated maximum concentration of hydrogen chloride was not considered to be a defining factor in determining the technical buffer.

The TLV-C for hydrogen chloride is 7 000 ug/m^3 and the IDLH is 150 000 ug/m^3 , thus the calculated maximum half-hour average concentrations of 79 to 166 ug/m^3 are very low compared to these values and show that there is no risk to health for this short-duration accident event.

CASE 6, TOLUENE (AROMATIC HYDROCARBON) EMISSIONS

Toluene is a solvent in widespread and common use. It was selected as being suitably representative of aromatic hydrocarbons, including benzene and xylene, which will be stored and

incinerated at the facilities. Toluene is more volatile than any of the xylenes and has a more stringent emission standard than benzene under Regulation 308.

Under normal circumstances in industry, these solvents are stored in a closed tank vented to the atmosphere; they are not stored under pressure. Similarly, following normal industrial practice, it was assumed that the storage tanks for these solvents will employ conservation venting systems with proper flame arrestors.

Toluene fire

This group of solvents is highly flammable. Any exposure to fire will cause the tank contents to burn. Unlike Case 3, partial combustion and the production of toxic fumes is not a consideration in this case.

A fire of a solvent such as toluene would involve complete combustion and could result in an explosion. These factors will be significant in the design of storage and handling systems for such solvents. The effects of such an explosion were judged to be localized in relation to technical buffer considerations based on gaseous emissions.

Toluene-tank "breathing" emissions

Filling of storage tanks will result in vapour already in the tank being displaced into the atmosphere. This "breathing" is unavoidable when tanks are being filled or emptied.

Calculations show that the emission of toluene from the tank vent during filling will be at a concentration less than the 2000 ug/m³ allowed by Regulation 308 at a distance of less than 75 m from the vent. This distance is within the operational area of the facility and is not a factor in determining the technical buffer.

Toluene - major spill due to rupture of storage tank

The possibility of a tank rupture without fire was considered. In this case it was assumed that toluene would be retained in a dyked area around the tank and would evaporate and disperse into the atmosphere.

A spill is a transitory condition and it was considered that occupational health and safety criteria rather than air pollution criteria should apply. A concentration of 10 times the TLV-TWA has been applied in similar conditions.¹² The calculated distance at which this occurs is less than a 100 m from the dyked area containing the spill.

At a distance of 120 m from the spill the calculated concentration as a half-hour average concentration is equal to the TLV-TWA of 375 ug/m³. It was concluded that the effects of such a spill would be predominantly within the operations area and thus not significant in defining the technical buffer.

CASE 7. POLYCHLORINATED BIPHENYL (PCB) STORAGE

The problems inherent in the handling and storage of polychlorinated biphenyls (PCB's) have been thoroughly reviewed in the M.M. Dillon report prepared in 1979 for the Ontario Ministry of

the Environment in 1979 and entitled "Facilities for Storage of PCB Wastes".¹³ This report documents the possible characteristics of a storage facility and some of the air emissions which might be expected under certain scenarios. This report also serves as a partial data source for current limitations on emission levels as proposed by the regulatory authorities. The report concludes that under normal operating conditions no problems would be expected provided that a minimum of a 300 m separation distance was provided between the emission source and the nearest sensitive receptor. It should also be noted that the report calculates that a further safety factor of 10:1 will be obtained at a distance of 1000 m. The report concludes that this safety factor would be beneficial but not mandatory.

The report clearly notes that under abnormal conditions such as a fire surrounding a storage tank, an evacuation zone as large as 2 km wide by 8 km long might be required. This is considered impractical in the OWMC case and certain engineering changes to the facilities characteristics envisaged in the 1979 report have been made to reduce this potential problem. These are summarized below:

- Storage of PCB's will be limited to a two month volume based on a 200 t/a input volume.
- The storage tanks will be earth covered over all but 18 in. (0.46 m) of their length to reduce fire exposure.
- The exposed end of the tank will be fireproofed with material having a thermal conductivity of 1.0 BTU/hr. ft.²°F (4.88 kcal/hr. m²°C) maximum.

- The vents from the tanks will be routed to a 10 m high stack.
- A foam type fire protection system will be installed. It is assumed that this system will limit the duration of any fire to a maximum of five minutes.
- The storage area will be arranged so as to limit the effects of any fire to a single tank.

Analysis of Results

With the storage assumptions as listed above, calculations carried out using the method specified in Ontario Regulation 308 show a maximum 1/2 hour average concentration of 205 ng/m³ at 150 m from the source and a concentration of 106 ng/m³ at 400 m from the source based on fire exposure of a storage tank containing high strength (70%) PCB.

The MOE suggested maximum half hour concentration for PCB is 450 ng/m³. This is slightly lower than the TLV-TWA of 0.5 ng/m³ specified by the ACGIH for 54% chlorine content PCB compounds. Thus, the maximum half hour concentration of 205 ng/m³ is less than 50% of the allowable limit, and at the limit of the 400 m buffer zone, the concentration is less than 25% of the allowable. The fire exposure condition for PCB's does not constitute the overall worst case scenario for the plant.

RURAL VERSUS INDUSTRIAL SETTINGS

For use in Phase 3 of the site selection studies, it was concluded that a technical buffer distance of 400 m, measured from the

TABLE 4

**SUMMARY OF TECHNICAL BUFFER DISTANCES REQUIRED
BASED ON ACCIDENTAL EMISSIONS FROM
PHYSICAL/CHEMICAL TREATMENT PLANT AND INCINERATOR**

Based on an analysis of six accident cases involving gaseous emissions, the calculated technical buffer distances area as follows:

Case No.	Description	Technical Buffer Distance from Source of Emission	
		Rural Setting	Industrial Setting
1	Physical/Chemical Treatment Plant Hydrogen Cyanide Emission	Operations area is sufficient - no additional buffer required.	
2	Physical/Chemical Treatment Plant Hydrogen Sulphide Emission	360m	Operations area is sufficient - no additional buffer required.
3.	Incinerator-storage Trichloroethane Emission	360m	See above.
4.	Incinerator-Reduction in Scrubber Efficiency - Sulphur Dioxide and Hydrogen Chloride Emissions	Maximum ground level point of impingement concentrations are less than concentrations allowed by Regulation 308; no buffer required.	
5.	Incinerator - Total Failure of Scrubber System - Sulphur Dioxide and Hydrogen Chloride Emission	Maximum ground level point of impingement concentrations are less than concentrations allowed by Regulation 308; no buffer required.	
6.	Incinerator - Storage Toluene Emissions; Fire; Tank Breathing and Spill	Operations area is sufficient; no additional buffer is required.	
7.	PCB Storage	Operations area is sufficient - no additional buffer is required.	

probable source of emissions in the core of the operations area, would be used for rural settings. This results in a site size of 80 ha for the rural setting as shown on Figure 1 (Chapter 2).

Under the normal operating conditions at the physical/chemical treatment plant and the incinerator, the air emissions will be equal to or better than those allowed in Regulation 308 and will satisfy the ambient air quality objectives of Regulation 296. The rationale used by the Province of Ontario in setting these emission standards and objectives is based on avoiding significant known effects to the environment. Compliance with these Regulations will result in the normal continuous emission to the atmosphere from the OWMC facilities having no significant environmental or health effects. Consequently, based on normal operating conditions only and considering only emissions to the atmosphere, it appears that no technical buffer is required beyond the operations area in a rural or industrial setting. In an industrial setting, especially with existing heavy industry, the impacts from normal operations would not constitute a nuisance and a technical buffer does not appear to be necessary.

For the potential accident conditions, as analyzed for the six emission cases, short-term non-continuous emissions will occur. With a 400 m technical buffer in a rural setting, the conditions at the buffer limit will be equal to or better than those allowed in Regulation 308. Compliance with the Ontario emission standard during these potential accidental emission events suggests that there will be no significant effect to the immediate environment and that minimum nuisance will result in a rural or light industrial setting.

CHAPTER 5 LAND USE COMPATIBILITY

INTRODUCTION

In Ontario, the precise dimensions of a buffer zone around a waste management facility are not specified by legislation. In effect, from a land use compatibility standpoint, the buffer zone is determined by assessing the potential impacts resulting from a particular facility in relation to the existing and future uses of the land surrounding the facility.

The Ministry of the Environment has legislative authority under the Environmental Protection Act, the Ontario Water Resources Act, the Environmental Assessment Act and the Planning Act to recommend or require separation distances and other control measures on land use planning proposals to prevent future incompatibilities between land uses.

The Ministry of the Environment policy on land use compatibility is set out in the Ministry's Policy Manual and in various guidelines prepared by the Ministry. The intent of the policy, as stated in the policy manual, "is to achieve a reasonable degree of protection that supplements practical emission controls, without unduly restricting land use".

As part of the Phase 3 site selection studies, a review was made of the Ministry's policy document and guidelines relating to land use compatibility. This review is included in full as Appendix "A" of this report. This chapter includes a summary of the existing policy and guidelines as they may relate to the Corporation's proposed facilities.

SEPARATION DISTANCES

To assist in the initial planning of new developments, the Ministry has prepared guidelines for the minimum separation distance between sensitive land uses and the source of emissions. In this case, emissions include noise, vibration, dust, odour, etc., in addition to air emissions.

Sensitive land uses, in addition to residences, include schools, hospitals, senior citizens homes and other institutional uses. Separation distance is the distance between the source of emission and the sensitive land use. Ownership of the land within the separation distance is not required of the developer of a new facility causing emissions. Preservation of a separation distance initially required for existing land uses may require planning controls to be used in the future.

The Ministry's interim guideline for recommended acceptable separation distances is presented as Table 5, which also includes the Ministry's notes relative to the guideline distances.

POTENTIAL IMPACTS

DISPERSION OF EMISSIONS FROM THE STACK

Preliminary studies of the emissions from the stack of the incinerator under normal operating conditions have been made by the Ontario Research Foundation in association with Gartner Lee Associates Limited.³ The ORF studies to date have considered dispersion of emissions from the incinerator stack using two alternatives:

- i) a relatively short stack on a large site;
- ii) a taller stack on a small site.

The flue gas cleaning system at the incinerator will employ the best proven technology and emissions from the stack will meet or better the emission requirements of regulatory agencies in Ontario. Pollutants will, however, be emitted from the stack in small quantities. These will disperse in the atmosphere and eventually reach the ground.

With a short stack the ground level point of impingement will be closer to the stack than with a taller stack and the pollutant concentration at point of maximum impingement will be higher. Thus, with a short stack it would appear possible to design the site to contain the maximum concentration of pollutants within the site. Concentrations further from the site would be progressively less and well below recommended air quality standards. This approach appears attractive as it provides "containment at the source", because a major portion of the emissions is being retained on the site of the facility. ORF concluded that this apparent advantage was offset by the shortcomings of a short stack. The shortcomings identified by ORF are:

- the plume emitted from the short stack may, under certain meteorological conditions, travel some distance before being brought down to ground level resulting in excessive pollutant levels beyond the site boundary;
- the intentional impingement of the relatively higher concentrations of emissions within the site could require secondary control measures to ensure that local contamination of the environment did not occur.

For these reasons, ORF concluded that "a taller stack which provides adequate dispersion under all foreseeable conditions, and thus ensures recommended ground level concentrations are not exceeded both within and beyond this site boundary is the more realistic design approach to be followed".³

ORF also concluded that with the taller stack, the atmospheric dispersion of emissions has little relevance to the shape of the site. Average wind direction frequencies in most areas of Southern Ontario, including the Golden Horseshoe, are relatively evenly distributed, and would imply approximately equivalent site and study dimensions in all directions from the incinerator stack.

The taller stack referred to by the ORF is in the range of 35 to 100 m in height. The following discussion of the ORF findings is limited to this height range for the stack.

ORF used previously reported estimates of emission rates to determine the distance from the stack to the point of maximum ground level concentrations for various stack heights and various meteorological conditions. These distances for neutral or unstable meteorological conditions ranged from 410 to 1050 m for a 35 m stack; and 825 m to 4300 m for a 100 m stack. Under extremely stable meteorological conditions the distances from the stack to the point of maximum ground level concentration were greater than 10 km for the 35 m and 100 m stack heights.

As would be expected, the shorter stack resulted in the higher maximum concentrations impinging closer to the source. As stack height increases, maximum point-of-impingement concentrations decrease while the point-of-impingement distance from the source increases. Maximum concentration values predicted for the criteria pollutants (particulate matter and nitrogen oxides) for

the 35 and 100 m stack are much less than those permitted by provincial standards. However, ORF noted that while the estimated concentrations were very low, criteria had not yet been developed for individual trace organic compounds and other emission constituents which might be of concern.

Distances at which the maximum point-of-impingement concentrations occur downwind of the source are within 1050 m of the source for the 35 m stack, with highest concentration calculated to impinge within 410 m. The maximum point-of-impingement concentration of the plume from the 100 m stack can occur up to 4.3 km from the source, but the concentrations associated with these distances reflect the extensive dilution of pollutants which has occurred, resulting in insignificant ground level concentrations.

Very preliminary deposition calculations were used by ORF to estimate the build-up of pollutants at a receptor surface over a period of time. For example, at a point 410 m downwind of the 35 m stack a total of 2.2 g/m² of particulate matter could be deposited over a period of one year. ORF concluded that this represents a relatively insignificant amount assuming that the particulate matter is inert and non-toxic in nature. However, in the case of toxic trace constituents such as metals, or persistent organic compounds, much smaller amounts could prove to be of concern relative to their long-term build-up in a sensitive environment.

The ORF study went on to note that a zone of 1 to 2 km might have to be considered to provide sufficient dilution of the pollutants from the incinerator stack.

The conclusions of the ORF³ study included the statement:

"To summarize, potential zones of influence have been defined as a general indicator of the approximate magnitude of sites and buffer zones that might be required. However, it is premature to specify the actual size of site or buffer zone that will be required for each facility option to ensure that no significant impact on local air quality occurs. More detailed system design and emission data are required to permit more quantitative estimates of site size requirements. Site shape requirements relative to atmospheric dispersion can be quite simply stated. Since wind directions are quite evenly distributed in Ontario, it would appear reasonable to locate facilities centrally on a site. The presence of particularly sensitive receptor areas in the vicinity of any given facility, or, of any unusually predominant prevailing wind directional experienced locally at a specific site, could justify an exception of this general guideline."

In the technical approach to the buffer sizing it was concluded that normal operating conditions at the incinerator did not represent a serious condition in terms of potential impacts on nearby adjacent land users. A tall stack would result in insignificant ground level concentrations with the maximum point-of-impingement concentrations being about 1 km to 4.3 km from the 100 m stack depending upon atmospheric conditions. The distances of 1 km and 5 km were adopted as the radii of study areas around the plant site. Existing land uses and environmental sensitivity were studied within 1 km; and population distribution, agricultural land use and ambient air quality within 5 km.

POLICY AND GUIDELINES

Based on a review of the Province's Land Use Compatibility Policy and the existing guidelines, the following conclusions were arrived at in relation to the OWMC proposed facilities.

- The OWMC facilities obviously will constitute a new source of emission regardless of their location.
- The MOE's policy will apply - i.e. to minimize the exposure of humans, including existing and future residents, to the adverse environmental effects of incompatible land uses.
- The OWMC facilities (transportation, storage, processing, and ultimate disposal) require consideration in relation to the MOE's policy regarding land use compatibility.
- Existing Guidelines for separation distances are related primarily to separation from residences and are normally measured from residential buildings to the property line of emission sources, but may be measured from industrial/utility structures or activity areas with the Ministry's approval.
- Sensitive uses, in addition to residences, include schools, hospitals and senior citizens homes and similar institutional uses.
- Existing guidelines for separation distances are difficult to apply directly to the OWMC facilities. A heavy industrial land use is considered to be most representative of the incinerator, i.e. separation distance greater than 300 m. A medium to heavy industrial land use is considered most representative of the physical/chemical treatment plant, i.e. separation distance 90 m to greater than 300 m.
- The separation distances for landfills as given in the MOE's "Draft Guidelines for Development on or Near Landfills", dated 9 February 1983, apply to sanitary landfills rather than an engineered landfill receiving solidified waste as

TABLE 5
RECOMMENDED MINIMUM ACCEPTABLE SEPARATION DISTANCES:
MINISTRY OF THE ENVIRONMENT INTERIM GUIDE^B

<u>Sensitive Land Use (Measured from)^E</u>	<u>Emission Source (Measured To)^E</u>	<u>Separation Distance^{C,D}</u>
Residential (buildings)	Light Industrial (property line)	60 m
Residential (buildings)	Medium Industrial (property line)	90-300 m
Residential (buildings)	Heavy Industrial (property line)	>300 m
Residential (buildings)	Utility: Sewage Treatment Plants	
	- small and medium-sized ($<25\ 000\ m^3$)	150 m
	- large ($>25\ 000\ m^3$)	>150 m
Residential (buildings)	Utility: Sewage Lagoons (property line)	100-400 m
Residential (buildings)	Gravel and Sand Pit (Licensed Extraction Area)	150m ^F
Residential (buildings)	Quarry Extraction (Licensed Blasting Areas)	500m ^F
Residential (buildings)	Agricultural Feed and Grain Drying Operations, Livestock Sales Yards (Property Line)	200 m
Residential (property line) ^G	Waste Disposal Site (Perimeter of Landfilled Area)	500 m

NOTES:

- A Revisions to this Schedule may be made without formal amendment of this Policy Statement, satisfactory to the Ministry of the Environment.

TABLE 5
(continued)

- B** The separation distances specified are to be used as a guide in the interim until more studies, specific policies or detailed guidelines indicate their required revisions. Certain other uses may also be added, such as certain commercial uses with emissions, after appropriate study.
- C** The separation distances are recommended as minimum acceptable for general application. They are to be:
- used as the starting point from which to examine the best way to avoid land use conflicts, for specific land uses, proposed within the rather general land use categories; and,
 - considered in conjunction with other available buffering techniques, including as a final measure, receptor-oriented controls, to minimize adverse effects.
- D** Variations from these separation distances may be recommended:
- on a case-by-case basis, in consultation with the Ministry of the Environment, depending upon local conditions, special physical, social and economic circumstances and the effectiveness of other techniques; and
 - where individual circumstances warrant, by municipalities, who may choose to adopt greater separation distances.
- E** Separation distances should normally be measured from residential buildings to the property line of the emission sources. After the proposed location of the emission sources and receptors are known, consideration will be given to measuring the separation distances from the industrial/utility structures or activity areas, if: they represent the major sources of emission; and, their location is controlled, such as in a zoning by-law.
- F** This is an area in which information on land must be provided under the proposed Aggregates Act. The area of influence will be determined on a site-specific basis.
- G** Where residential use and waste disposal sites are proposed in proximity to one another, the separation distance should be measured from the residential property boundary, to avoid hard surfaces extending the possible methane gas migration range.

envisaged by the OWMC. The 500 m separation distance suggested by the guideline is a maximum based on research by the Ministry's Gas Migration Committee. Landfill gas is a significant concern with the decomposition of garbage, which is mainly organic, but not with solidified inorganic wastes. The 500 m separation distance adopted by OWMC appears appropriate as a study area for sensitive land uses in relation to the engineered landfill.

- The separation distance guidelines issued by the Ministry for sewage treatment plants and sanitary landfills relate to the actual sources of emission or active areas of the site rather than the site property limits or site boundary. The maximum separation distances in the guidelines are viewed as study areas for assessing potential impacts and not as areas to be owned by the developer of the utility.
- The thrust of the policy document for land use compatibility is to protect humans from adverse environmental effects including nuisance effects which will detract from their enjoyment of their property. This can be achieved by studying the potential effects (degree, duration, frequency, dispersal distance) and identifying an area of influence. Part or all of this area of influence can be defined as a buffer area where land use controls are used to minimize significant adverse effects on sensitive land uses.

BIBLIOGRAPHY

1. Documentation of the Threshold Limit Values for Substances in Work-room Air, American Conference of Governmental Hygienists, 3rd Edition (1977). Updated by Supplement to 1983-84.
2. Conceptual Design Brief, Proctor & Redfern Group, 31 January 1983. (Draft) 50 pp., Appendices. (Available from OWMC).
3. Site Size and Shape, Gartner Lee Associates Limited and Ontario Research Foundation, May 1983 (Draft). 20 pp., (Available from OWMC).
4. Waste Quantities Study, Proctor & Redfern Group with Weston Designers - Consultants and Ontario Research Foundation, August 1982. 68 pp., Appendices. (Available from OWMC).
5. The Rationale, Methodology and Administration Used in Ontario to Determine Ambient Air Objectives and Emission Standards, C. Bruce Martin and P. C. Kupa, Ontario Ministry of the Environment, 70th Annual Meeting, Air Pollution Control Association, Toronto, 19-24 June 1977.
6. Generic Process Technologies, Proctor and Redfern Group. August 1982. 224 pp., Appendices. (Available from OWMC).
7. Water Management, Ministry of the Environment, November 1978. 64 pp., Bibliography.
8. Sewage Systems in the Golden Horseshoe, Proctor and Redfern Group, 20 January 1983. (Draft). 22 pp., Tables. (Available from OWMC).
9. Transportation of Special Wastes in Ontario, Pilorusso Research Associates Inc., September 1983. 110 pp., Appendices. (Available from OWMC).

BIBLIOGRAPHY

(continued)

10. European Tour Report, Proctor and Redfern Group, 30 September 1983. 94 pp., Appendicies. (Available from OWMC).
11. Fundamentals of Industrial Hygiene, 2nd Edition, National Safety Council, Chicago, Illinois. (1979).
12. Technical Information on Problem Spills, Environment Canada, (1981). Beauregard Press Limited. 104 pp.
13. Facilities for Storage of PCB Wastes, M.M. Dillon Limited, (1979). Final Report prepared for MOE, Dillon Contract 8433-01. 329 pp., (Available from OWMC).

APPENDIX "A"
LAND USE COMPATIBILITY
REVIEW OF MINISTRY OF THE ENVIRONMENT'S POLICY AND GUIDELINES

No legal requirement exists in the Province for the precise dimensions of a buffer zone around a waste management facility.

The Ministry of the Environment has legislative authority under the Environmental Protection Act; the Ontario Water Resources Act, the Environmental Assessment and the Planning Act to recommend separation distances and other control measures on land use planning proposals to prevent future incompatibilities between land uses.

The Ministry of the Environments policy on "Land Use Compatibility" is set out in the MOE Policy Manual. The intent of the policy "is to achieve a reasonable degree of protection that supplements practicable emission controls, without unduly restricting land use".

Certain definitions, as listed below, are included in the MOE Policy Manual and provide a context for the considerations of buffer zone for the OWMC facilities.

"BUFFER

In a land use context, a buffer can be:

1. a space; or
2. a feature; or
3. a land use; or
4. any combination of the above

interposed between two conflicting land uses for the purpose of reducing or eliminating the adverse effects of one land

use upon the other. A buffer may be an open space, where distance alone is relied upon to produce the desired results, or it may be a berm, wall, trench, fence or other structure or plantings, or other land use differing from the conflicting ones, but compatible with both.

INFLUENCE AREA

The area(s) identified around a source(s) of emission subject to one of a number of adverse environmental effects of varying duration, frequency and distance of disposal.

BUFFER AREA

The area between an emission source(s) and nearby sensitive land uses, where land use controls are used to minimize any significant adverse effects. It can be of variable size, shape and composition to produce the desired results and apply to all or part of an Influence Area.

LAND USE COMPATIBILITY

A recognized factor and principle of good land use planning, whereby land uses which are known or expected to cause environmental problems for one another, when in proximity, are deemed incompatible and are protected from one another by separation or other means."

This land use compatibility policy is applied by the MOE where a proposed change in land use has the potential to create significant adverse environmental effects on another land use(s). The MOE will apply the policy to development applications reviewed by MOE at the request of and under the Agencies' legislation; in particular in the review of official plans and amendments, zoning by-laws and amendments, etc. The policy is applicable:

- a) where new residential uses or other sensitive uses are proposed within the influence area of other existing emission sources and/or
- b) where new sources of emission are proposed close enough to existing residential uses, or other sensitive uses, so as to adversely effect them

The MOE Policy document involves the following statement regarding Objective of Policy - "The objective of this policy is to minimize the exposure of humans, including existing and future residents, to the adverse environmental effects of certain incompatible land uses".

The scope of the MOE policy involves all land uses conflicting with residential use, or other sensitive uses, and includes land use for industry, transportation, utilities, agricultural operations, commercial and intensive recreational uses. The MOE policy is based on the assumption that certain kinds of adverse environmental effects from the foregoing land uses are difficult to control, at the source, under all circumstances, all the time and include: noise and vibration; gas; odour; particulates and other contaminants.

The MOE's statement of their policy is summarized in the document as follows:

"It is the policy of the Ministry of the Environment to recommend the separation of incompatible land uses, where necessary, in the review of land use plans as a preventative means of achieving environmental objectives of the Ministry. There is an Influence Area around certain facilities or land uses, where exposure of residents and other sensitive uses should be minimized. These areas should be identified at an early stage in land use planning. Necessary environmental control measures, such as placing Buffer Areas between emission sources and residential or sensitive land uses, should be applied, to supplement practical emission controls, but not to take the place of such controls".

Implementation of the MOE policy on land use compatibility is by staff review of proposed planning documents, and by Regulations, detailed policies, guidelines and studies.

No regulations exist in Ontario to precisely define influence areas or buffer areas to be applied in cases of land use incompatibility. Various guidelines relating to land use and separation distances from various utilities and industries have been issued by the Ministry of the Environment. These guidelines are summarized in the following:

GUIDELINES FOR LAND USE SURROUNDING SMALL AND MEDIUM SIZED SEWAGE TREATMENT PLANT (MOE ENVIRONMENTAL APPROVALS BRANCH JANUARY 1978)

- Guidelines apply to plants with a design capacity up to 25 000 m³/day.
- Concerned with potential for odours from sewage treatment plants.
- Recognizes that well-designed, well-monitored and well-operated plant not loaded beyond design capacity rarely produces odours beyond boundary of plant itself.
- Recognizes that sewage plants may be inadvertently overloaded or upset by toxic wastes and may produce objectionable odours at considerable distances.
- Recognizes that minor upsets may occur at almost any sewage treatment facility and considers it prudent that surrounding land use be carefully planned.
- Land adjacent to sewage treatment plant should preferably be for other than residential uses.
- Separation distances from residences are recommended:
 - . Sewage Treatment Plants
 - Measured from open plant structures

Where practical - 150 m

Minimum - 100 m

. Lagoons

100 to 400 m desirable depending upon the size of the lagoon and the loading rate. Consultation with staff recommended. Separation distance recognizes that lagoons are more likely to be sources of odours than mechanical plants and that odours may persist for two or three weeks when the ice cover melts in the Spring.

Plants with capacities of greater than 25 000 m³/day are considered on an individual basis and a separation distance greater than 150 m may be recommended, or covering of open structures and treatment of emissions may be required.

The guidelines note that the Ministry of the Environment will not adversely criticize proposed residential developments in the vicinity of sewage treatment plants if there is no history of objectionable odours in the neighbourhood and provided the guidelines are being met.

The key element of these guidelines appear to be that the nuisance of odours to nearby residents is to be avoided by a separation distances of at least 100 m and preferably 150 to 400 m measured from the nearest open structure or water surface for a mechanical plant and lagoon respectively.

The guidelines do not directly mention noise, vibration, dust or visual impacts and these can be considered to be adequately covered by the separation distances given. Furthermore, the guidelines deal with separation distance only and do not

specifically deal with influence area or buffer area. Also, the guidelines do not consider ownership of the land within the separation distance.

RECOMMENDED MINIMUM ACCEPTABLE SEPARATION DISTANCES
- MINISTRY OF THE ENVIRONMENT INTERIM GUIDE

These guidelines are reproduced in the following table. In relation to the OWMC facilities, the MOE recommended minimum separation distances for medium and heavy industrial land use and waste disposal sites (sanitary landfill) are of interest. For industrial land use the separation distances are normally measured from the nearest residential building to the property line of the emission source i.e. the industry. This may require that the effective "property line" of the physical/chemical treatment facilities and incinerator be defined, e.g. an emissions core within the operations area.

DRAFT GUIDELINES FOR DEVELOPMENT ON OR
NEAR LANDFILLS, DATED 9 FEBRUARY 1983

In summary, the guidelines apply to sanitary landfills and dumps, as defined in Regulation 309, of the Environmental Protection Act, R.S.O. 1980.

It is emphasized that a sanitary landfill receiving municipal garbage cannot be directly compared to an engineered secure landfill as proposed by the OWMC. Nevertheless, the MOE Guidelines do provide an indication of current thinking in Ontario. The rationale for these guidelines considers landfill operating factors having potential impacts on nearby residents i.e. landfill gas (methane), leachate, odour, litter, dust, noise, sectors and vermin, disposal site fires, truck traffic, air emission from machinery and trucks, and visual impacts. Based on these factors the guidelines include the following separation distances:

RECOMMENDED MINIMUM ACCEPTABLE SEPARATION DISTANCES:
MINISTRY OF THE ENVIRONMENT INTERIM GUIDE

<u>Sensitive Land Use (Measured from)</u>	<u>Emission Source (Measured To)</u>	<u>Separation Distance</u>
Residential (buildings)	Light Industrial (property line)	60m
Residential (buildings)	Medium Industrial (property line)	90-300m
Residential (buildings)	Heavy Industrial (property line)	>300m
Residential (buildings)	Utility: Sewage Treatment Plants	
	- small and medium-sized ($<25\ 000\ m^3$)	150m
	- large ($>25\ 000\ m^3$)	>150m
Residential (buildings)	Utility: Sewage Lagoons (property line)	100-400m
Residential (buildings)	Gravel and Sand Pit (Licensed Extraction Area)	150m
Residential (buildings)	Quarry Extraction (Licensed Blasting Areas)	500m
Residential (buildings)	Agricultural Feed and Grain Drying Operations, Livestock Sales Yards (Property Line)	200m
Residential (property line)	Waste Disposal Site (Perimeter of Landfilled Area)	500m

"GAS"

To deal with gas concerns, a minimum required separation distance (buffer area) between the perimeter of a landfilled area and any services, structures or facilities of a sensitive land use is 20 m. This is to allow for the installation, servicing and monitoring of any required technical control devices.

A maximum separation distance required between the perimeter of the landfilled area and any services, structures or facilities of a sensitive land use would be 500 m. This maximum separation distance is based on research conducted by the Ministry's Gas Migration Committee, and covers any existing or proposed landfill site in Ontario (with the view that any fill would have a depth less than 50 m).

Therefore no development should take place within 20 m of the landfilled area, and where development is proposed within 500 m of the perimeter of the landfilled area, evidence should be provided by the developer to the approving authority that gas will not constitute a problem"

The Guidelines conclude that "Accordingly, when reviewing for gas concerns, it is conceivable that development could take place between 20 m and 500 m of a landfilled area, and technical control devices or other buffering techniques may or not be necessary. Beyond the 500 m distance the Ministry would not normally anticipate gas migration."

"LEACHATE"

When development or redevelopment is proposed, the approach to deal with potential leachate problems is dependent upon the source of water supply:

1. Development serviced by municipal waterworks:

- If the development is within 30 m (approximately 100 yds.) of a landfilling site, the developer should check for the presence of leachate, as it may have a damaging (corrosive) effect on the underground utilities.
- If the development is beyond 30 m, it is unlikely that there would be enough contamination in the

ground water to affect the utilities, and therefore, leachate should not be a concern (examples of exceptional situations are areas of fractured rocks and sand).

Therefore, as corrosion may be a concern where municipal waterworks will be within 30 m of a landfilled area, within this distance the developer should determine if leachate will in fact pose a problem, and if there are remedial or alternative measures available. See also note No. 1 on page 3 which deals with utility lines and gas concerns.

2. Development serviced by wells and septic tanks:

- For any proposal using wells or septic tanks, regardless of whether there is an operating or closed landfill site in the vicinity, the developer may be asked to provide evidence from a qualified expert, if deemed necessary by MOE staff in consultation with the municipality, that the water supply meets with MOE drinking water objectives (refer to the Water Resources Branch guidelines "The Application of Drinking Water Objectives to Ground Water Supplies in Ontario").

Thus, in this case there may be concerns within and beyond the 30 m distance reference on page 4, particularly where development is proposed adjacent to a required buffer area.

THE OTHER ENVIRONMENTAL EFFECTS

The following applies for operating sites:

- Most of the adverse environmental effects will not extend beyond 500 m of the landfill(ed) area.
- Normal exceptions to this are truck traffic, odour, and litter. The range for these problems has been found to extend from 1 to 2 km, based on MOE field experience.
- If there are any adverse nuisance effects beyond the 500 m distance, they should be apparent without costly studies.

- Thus, the overall maximum distance within which adverse effects could be experienced is approximately 2 km, but most occur within 500 m.

Therefore, for the purposes of plan review where there is an operating landfill, the presence and degree of impact of adverse environmental effects should be investigated within a 500 m distance of a landfilled area.

- This does not mean that a 500 m separation distance is necessarily required between the landfilled area and sensitive land uses. Rather, the presence of environmental effects should be considered for any proposal within 500 m of the landfilled area. Thus, development may be appropriate within 500 m of a landfilled area, where there is evidence provided by the developer to the approving authority that no adverse effects exist, or that adverse effects can be mitigated through remedial measures.
- Where it is evident that nuisance effects will be/are experienced by developments beyond 500 m, remedial measures and/or a "warning" may be provided for the development.
- Again, it is the responsibility of the disposal site owner/operator to ensure that environmental effects are controlled as required by MOE on the disposal site itself."

In essence the Ministry's "Draft Guidelines for Development On a Near Landfills" apply to sanitary landfills receiving municipal garbage. The 500 m separation distance is viewed as a study zone. The 500 m distance is based on the potential for uncontrolled migration of landfill gas and minimizing other environmental nuisance effects (e.g. noise and dust and visual impacts) on nearby residents. These Guidelines also recognize that odour, litter and truck traffic may have a wider range of influence from 1 km to 2 km.

It is important to distinguish between a sanitary landfill and an engineered secure landfill as proposed by the OWMC. A

sanitary landfill receives mainly domestic garbage which is predominantly organic (e.g. food waste, garden wastes, paper, wood). The decomposition of these organics produces landfill gas (e.g. methane) which can migrate from the landfill area in the absence of engineered controls and/or suitable soils. Similarly, leachate is produced by the percolation of rainfall in the absence of control works and soils of extremely low permeability.

The OWMC is committed to the pretreatment of all wastes prior to secure storage. Additionally, the processed wastes to be land-filled will be mainly inorganic. The ultimate disposal of organic wastes will generally be by incineration. Thus, the generation of methane should not be a cause of concern with the OWMC landfill.

A major objective of solidifying inorganic wastes or treatment residues prior to secure storage in an engineered landfill is to avoid the leaching of chemical constituents by rain water. Also, the principal objective of the engineered landfill is containment of the solidified waste and any leachate to avoid migration from the landfill. Any leachate produced will be collected and treated. Leachate production will be minimized by minimizing the entry of surface drainage water into the secure landfill, including the use of impervious covers over completed cells of the landfill.

Similarly, by virtue of pretreatment and solidification odours are not anticipated to be a problem and dust production will be minimized.

In summary, the principal impacts from the OWMC's engineered landfill will be related to the noise of operating equipment and trucks and visual impact.

CONCLUSIONS

Based on the review of the MOE Land Use Compatibility Policy and the guidelines that exist, it is concluded that:

- The OWMC's facilities obviously will constitute a new sources of emission regardless of their location.
- The MOE's policy will apply i.e. to minimize the exposure of humans, including existing and future residents, to the adverse environmental effects of incompatible land uses.
- The OWMC's facilities (transportation, storage, processing, and ultimate disposal) require consideration in relation to the MOE's policy regarding land use compatibility.
- Existing Guidelines for separation distances are related primarily to separation from residences and are normally measured from residential buildings to the property line of emission sources, but may be measured from industrial/utility structures or activity areas with the Ministry's approval.
- Sensitive uses, in addition to residences, include schools, hospitals and senior citizens homes and similar institutional uses.
- Existing guidelines for separation distances are difficult to apply directly to the OWMC's facilities. A heavy industrial land use is considered to be most representative of the incinerator, i.e. separation distance greater than 300 m. A medium to heavy industrial land use is considered most representative of the physical/chemical treatment plant, i.e. separation distance 90 m to greater than 300 m. The separation distance for the engineered landfill would appear to be

closer to the minimum of 20 m rather than the maximum of 500 m used for sanitary landfills receiving municipal and other refuse.

- The separation distance guidelines issued by the Ministry for sewage treatment plants and sanitary landfills relate to the actual sources of emission or active areas of the site rather than the site property limits or site boundary. The maximum separation distances are viewed as study areas for assessing potential impacts and not as areas to be owned by the developer of the utility.
- The thrust of the policy document for land use compatibility is to protect humans from adverse environmental effects including nuisance effects which will detract from their enjoyment of their property. This can be achieved by studying the potential effects (degree, duration, frequency, dispersal distance) and identifying an area of influence. Part or all of this area of influence can be defined as a buffer area where land use controls are used to minimize significant adverse effects on sensitive land uses.

APPENDIX "B"
ASSUMPTIONS

1. Storage tanks for all materials subject to freezing will be located indoors. This will include all material scheduled for Physical/Chemical Treatment.
2. The enclosed storage area will be 120 ft. (36.6 m) x 240 ft. (73.2 m). Eave height will be 20 ft.(6.10 m) over the waste storage tanks. Roof slope will be 1 in 4.
3. Incinerator waste storage will be out of doors since little of the material is likely to be subject to freezing. Tank heating and line tracing will be provided in the few cases where such protection is necessary.
4. Enclosed storage and operating areas will be ventilated at the rate of five air changes per hour under normal conditions and ten per hour under emergency conditions.
5. Waste sulphide material will occur in solid form whether in suspension (sludges) or as dry or semi-dry filter cake.
6. Reaction of sulphide materials with dilute strong acid will be assumed to follow the same time sequence of generation of H_2S as the laboratory reaction using Zinc Sulphide.
7. The acceptable 1/2 hour concentration for H_2S is 30 ug/m³.
8. Spent acid contains 4% H_2SO_4 .

9. The average composition of halogenated hydrocarbons fed to the incinerator is CCl_4 15%, 1,1,1-trichloroethane 85%. Sludges and contaminated solids are assumed to contain 20% chlorine.
10. 1,1,1-trichloroethane is assumed to be the most volatile halogenated hydrocarbon stored in quantity. The maximum storage volume is assumed to be 2,500 US gallons (9 465 L).
11. The allowable 1/2 hour concentration limit for 1,1,1-trichloroethane is 350 000 ug/m^3 .
12. Maximum height of the incinerator stack is 100 m.
13. Ventilation fans are set at the highest point of the building roof.
14. Tank dykes are sized to hold 150% of the tank contents with a 3 ft. (0.91 m) wall.
15. In the case of total scrubber failure, all waste feed to the incinerator would be shut off in three minutes.
16. Building ventilation would remove 50% of any contaminant per air change.
17. There is assumed to be no effect from a fire located at grade at elevations greater than 25 ft. (7.62 m).
18. Storage tanks for non-freezing materials are not insulated.

19. Storage of PCB's will be limited to a two month volume based on a 200 t/a input volume.
20. The PCB storage tanks will be earth covered over all but 18 in. (0.46 m) of their length to reduce fire exposure.
21. The exposed end of the PCB storage tanks will be fireproofed with material having a thermal conductivity of 1.0 BTU/hr. ft.²/°F (4.88 kcal/hr. m²/°C) maximum.
22. The vents from the PCB storage tanks will be routed to a 10 m high stack.
23. A foam type fire protection system will be installed in the PCB storage area. It is assumed that this system will limit the duration of any fire to a maximum of five minutes.
24. The PCB storage area will be arranged so as to limit the effects of any fire to a single tank.